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FORECASTING, PLANNING AND BUDGETING IN BUSINESS MANAGEMENT

FORECASTING, PLANNING AND BUDGETING IN BUSINESS MANAGEMENT

BY

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PREFACE

During the past two decades, changes of a basic nature have taken place in business management. Whether or not these changes had their rise in the so-called scientific management movement is uncertain; but it is widely conceded that they partake of the principles promulgated by the founders of this movement.

A significant, and perhaps the most significant, feature of scientific management is that of planning. Better planning was the end and aim of Taylor's earliest experiments, with the cutting of metals. Planning as a conscious function, built upon scientific forecasts, was painstakingly perfected in production departments, but other departments of business, realizing its value, were quick to follow suit.

Today, competition has forced executives to forecast, to schedule, to plan, and to make budgets. This book is offered in answer to the demand for a manual of planning practice. It aims to give practical help to the business man, in all his tasks which have to do with the future. To students, it should serve as a means for transition from the more academic processes of thought to those of the shop and office. For those curricula in which planning is approached systematically, this book, it is hoped, will serve as a suitable text.

Forecasting services have flourished for a considerable period, and have proved their usefulness. Their greatest shortcoming, however, is that their recommendations are necessarily general, and given in such a form that the ordinary business man is at a loss to know how to apply them. A secondary purpose of this book is to show how such basic data may be applied to the problems of the individual business.

The writing of this book was begun by the author many years ago. Subsequently, Dean Frederick B. Robinson and Professor Maximillian Philip, both of the College of the City of New York, were prevailed upon to collaborate. Whatever merit the present text has is due largely to their efforts.

Walter S. Hayward has been of invaluable assistance: in fact, a great deal of the original work is his. Thanks are also due to Charles G. Wheeler, for reading proof, and to Miss Clara L. Treyz, for assistance in both the manuscript and manufacturing stages.

Percival White.

New York City
January, 1926

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CHAPTER I

INTRODUCTION

Business forecasts and scientific planning have increased rapidly in importance for a number of reasons, the chief of which are:

1. Predictions and plans based on statistical forecasts have proved of dollars-and-cents value under actual trial. They have served to avoid loss and have allowed correlation of activities through planning to a degree hitherto unknown.

2. The steady growth in size of business concerns has gradually changed the control of activities from a personal basis to a statistical basis. One man no longer governs the destinies of his business, as formerly. He must have lieutenants, and his survey of his business activities must be done through a study of graphs and statistics rather than through his own personal observations.

3. There has been a constant increase in the number of processes which intervene between the raw material and the final sale to the consumer. This has brought about great interrelation between various industries,

so that the fortunes of one invariably react in some measure upon another. The approximate effect is often statistically calculable.

4. The lack of balance between supply and demand, most noticeable in the so-called business cycle, and present in practically every business in the form of seasonal fluctuations, has brought attention to the various devices for foretelling such radical changes and making advance preparations.

5. The incessant publicity given to business forecasting has brought about a general interest in its possibilities. The various forecasting services have spent much money in advertising their accomplishments, and business schools have inaugurated courses which teach the principles of statistical prediction.

6. The force of competition is constantly compelling the abandonment of guesswork methods in favor of those founded on facts. Intuitive planning, or even planning based on experience, cannot compete with planning based on facts.

Definition.—Every approach to a scientific problem presupposes definitions. A prediction is a present estimate of circumstances and tendencies as they will exist at a specified time in the future. Its value will depend in great measure upon the accuracy and sufficiency of the data upon which it is based.

A scientific prediction is one that, in attempting to lay out the course of a future event, endeavors to take cognizance of all the facts and factors affecting the future of the prediction.

It is essential to understand the relation of prediction to planning. Prediction is an envisagement of a

future result that may be due to a combination of a number of discernible causes, possibly under the control of the predictor and possibly not. To plan is simply to schedule the measures which it is desired to take with the forces and materials available. Prediction is a guide to planning.

For example, a storm may be predicted within three hours. Nothing can avert the storm or influence it, but the individual can plan to stay indoors, or to carry an umbrella, or to catch some of the rain water to put in the battery of his automobile. Having the basic prediction of a storm, he can predict what would happen *if* he should go out with an umbrella but no rubbers, *if* he should go out with rubbers and no umbrella, *if* he should stay at home, and any number of other results *if* he should follow various courses of action. Taking some secondary prediction as a guide, he can plan to conduct himself and to use his resources so that these factors, coupled with the uncontrollable but predictable factor of the storm, will leave him in the best position.

So also, where the factors of a given causal sequence may be varied at will so as to make various results predictable, as in the case of some factory management problems, that combination is selected which warrants the most desirable prediction, and then the plan is made to realize the combination. Prediction is a guide to conduct; planning is the scheduling of that conduct.

The architect who designs a railroad terminal must predict, or have someone predict for him, traffic conditions for many years ahead, possible lines of

development, and many other things. He predicts the kind of results that he can get from certain materials arranged in certain designs. Then he plans to bring about the combination of results that give promise of greatest service in the light of the original traffic predictions.

Business Planning and Prediction.—Planning, as has been said, is applied prediction. Almost every business prediction suggests the necessity for a plan. Business planning takes into consideration the past, the present, and the future. While using the prediction, which is based upon statistics, it adds also the human factor of interpretation and judgment. Every great business man has been a great predictor. While in the past his predictions have often been intuitive, in the future, methods of prevision will be those of the laboratory man rather than those of the clairvoyant.

Prediction and planning presuppose a distinction between past, present, and future. This difference can be brought out more clearly by comparing these three states of time with three adjoining territories through which a railroad line runs, traveling from the past, through the present, toward the future. The present is that little region which surrounds the railroad train and which is illuminated by its lights. Beyond, in both directions, there is darkness. The fields which have been passed through are remembered but cannot be seen, while those the train is about to enter show up but dimly ahead.

Hard as it is to peer into the future, it is essential to do so. For this purpose, the locomotive is provided with a headlight which illuminates the rails, and allows

the engineer to see any dangers or obstacles ahead. By avoiding accidents, he can drive more safely at a higher speed.

The beams from the headlight illuminate the nearer objects more sharply than those which lie farther off. The brighter and better focused it is, the farther it is possible to see. This implies the need for installing the best headlamp which can be found, computing its projective power most scientifically, fashioning its parabolic surface with the most exacting care, and keeping it always highly burnished. In business, predictions and plans are used as headlights to illuminate the future.

Every business depends in some degree upon prediction. The speculative business, so called, is merely that one which is most difficult to forecast. Ordinarily speaking, the difference between a safe and an unsafe business is largely a matter of ability to predict. In other words, the more predictable a business becomes, the more likely it is to be successful. If the future of a business can be known, it can be provided for, and, therefore, the business becomes safe.

The Bases of Predictions.—Every prediction and every plan are made up of the following components:

1. Sources. These may be statistical compilations, the consensus of many opinions, the tabulation of observations or experiments, or other data worthy of serving as the basis of a prediction and a plan.

2. Interpretation. Statistics alone are not sufficient. They must be interpreted by someone cognizant of the situation and able to correlate the various factors, and to gather their true meaning.

3. Presentation. The methods of presenting the facts statistically, graphically, and personally are of the greatest importance. A prediction report and a written plan are advisable.

4. Application. After the statistics of the past have been gathered, interpreted, and presented, it remains to apply them to practical account in the major fields of purchasing, production, and marketing.

The technique of making predictions and turning them into business plans, carefully correlated with national and industrial plans, is a comparatively new science. Like all similar endeavors, it is still in an experimental stage. Yet the mere fact that it is possible to predict in many lines, and the short period of time over which statistics have been kept, show in some degree what may be expected in the future along the lines of scientific planning.

Sources of Predictions.—Predictions are founded upon facts. If these facts are inaccurate, if the number gathered is insufficient, or if the interpretation is faulty, the prediction will be nullified to a great degree.

Only the largest organizations, however, can afford to hire their own staff specialists to collect and to compile all the statistics necessary for purposes of prediction. The smaller concerns, which in many ways are in much greater need of scientific methods of planning, have neither the funds nor the resources to collect many of the necessary facts external to the organization but vital in their effect upon its activities. It will be necessary, therefore, for such concerns either to subscribe to the forecasting services avail-

able, or to accept the statistics of the various trade journals and reporting services, and from them to make up their own predictions.

The average concern will, therefore, take its facts from three series of sources:

1. External statistics (those having to do with general business conditions) will be taken in digested form from one of the forecasting services.

2. Industrial statistics (those having to do with the industry of which the company is a member, or perhaps with other industries which are closely related in cause and effect) will be taken from reporting services, such as Dun's, Bradstreet's, trade journals, and similar organizations.

3. Internal statistics (those having to do with the activities of the company itself) will be secured from purchasing, production, sales, and accounting records, or any other sets of company statistics which may prove suitable for purposes of prevision.

Interpretation.—The analysis of statistics prior to drawing up the prediction is one of the most important tasks in making a forecast. The person who makes this forecast must, therefore, possess in high degree the ability to correlate the various facts without bias and with due regard to the proper weight to ascribe to each. He must also be able to see ahead and take into consideration the various external forces which are at work and which may make the ultimate prediction deviate from its normal procedure.

The person who interprets the statistics should not necessarily make up the primary records. Indeed, the preliminary routine work is usually done by sub-

ordinates. But the interpreter should begin his task with the sorting out of the essential facts from the unessential ones.

The ultimate prediction is a resultant of forces. A great deal of its accuracy will depend upon the skill of the interpreter in assigning to each set of facts the weight or force which it will exert in determining the final result. Steps can then be taken to cope with the adverse factors. Indeed, prediction and forecasting have been defined as foresight of consequences and provision against them.

Presentation.—The value of the prediction is greatly lessened unless it is presented to the management in a usable and practicable form. This ordinarily implies graphic analysis, because the average executive has neither the time nor the technical training to digest a mass of statistics. Numerical relationships must be translated into diagrams before they can be judged accurately.

Predictions are usually submitted in the form of reports. The construction and the wording of these reports should be of the simplest, so that they may be readily understood by everyone concerned.

It is often of the greatest importance to have predictions and conclusions explained personally to the heads of the business. The forecaster should be able to participate in the discussions, and to show how he has arrived at his results.

Application.—The gathering of statistics and the making of predictions are practically useless unless they are to be put to work in the making of plans. The first place where they prove of utility is in the

layout of long-range policies. Each company wants to look ahead for a number of years so that it can provide for expansion and development of the business. It often happens, for example, that a manufacturer can see ahead to the time when he will have filled the demand for his product through present channels. If he is to continue expanding his business, he must find new uses for the product or provide new markets before the saturation point in the original market has been reached. Through correlation of statistics, he knows approximately what his present market is and how long it will be before he has satisfied it. He also knows that he must be prepared for the future increase in output of his factory. In some industries, this question is particularly acute. In the case of rubber, for example, experts are constantly devising new methods of disposing of the output.

Types of Predictions.—Scientific prediction falls into two main classes:

1. Predictions of effects in which the predictor can control the causes.

2. Predictions in which the predictor can observe but is powerless to control the result.

The first class of prediction is that of scientific method, pure and simple. For example, by laboratory tests it is proved that a drill of a certain standard specification will go through a steel plate of known grade and thickness in 30 seconds if operated at the rate of 200 revolutions a minute. The test has been made on a great number of plates, a table of results has been drawn up, and all errors corrected. As far as tools and machinery are concerned, the shop fore-

man can be told that two plates a minute should be punctured.

At this point, however, the second type of prediction enters, because it is not possible to predict with scientific accuracy how fast the individual operator of the machine will work. The prediction can be made, but it will now be based on statistics and averages of various sorts, and predictions will be more and more accurate as the number of operators involved increases. The second method, therefore, must be used where an essential factor cannot be controlled.

Life insurance is an excellent example of prediction where probabilities and chances are accounted for. Like the causes of variation in individual character, the causes of death at various ages are almost endless. Nevertheless, if enough cases of death are enumerated, a table can be constructed to show for each age what the predictable number of remaining years of life will be. This is known as a mortality table. By its use, insurance companies know how much money to charge as a premium during a period of years to enable them to pay death benefits when death does occur. Actuarial science has a low margin of error, even though based entirely on observation.

Business Plans.—Both types of predictions are used in the formation of business plans. The application of forecasting to the financial management of the company's affairs is particularly important. More and more attention is being paid to the question of budgets and budgetary control—a matter which lies almost entirely in the field of prediction.

Applied predictions, or plans, are also of the greatest value in purchasing, production, and marketing. By careful analysis of statistics and by correlation with the general trend of business, it is possible for the purchasing agent of a manufacturing concern, or the buyer for a retail store, not only to regulate his purchases according to size, but also to predict with a fair degree of certainty the price he should pay.

In the field of production, prediction is used to correlate volume of production with the volume of finished article which can be sold. Periods of over- and underproduction are being reduced by the use of prevision based on facts. Time and motion studies, scheduling, estimating, and a variety of other special phases of prediction are also used in production.

The analysis of markets, the setting of sales quotas, the formation of advertising budgets according to planned sales are also matters pertaining to prediction.

From the point of view of forecasting, purchasing, production, and sales are all part of the same process and should be carefully correlated so that activity in one department will be accompanied by activity in another, and so that advance preparations for increased production will be attended by adequate purchases and a suitable sales campaign. Since selling is the final and controlling process, the other two steps should be regulated by the planned volume of sales, and also by the seasonal fluctuation in sales.

The first step in studying practical prediction is an understanding of the various factors involved in making a forecast. These are treated in the following chapter.

CHAPTER II

FACTORS IN FORECASTING

The factors entering into predictions or plans can be roughly divided into two classifications: first, those which are foreseeable and which, therefore, can be insured against; second, those which are unforeseeable. No exact boundary line can be established between the foreseeable and the unforeseeable, since, as knowledge increases and as records accumulate, there is a tendency for factors originally placed in the latter class to move into the first.

A second group of factors is concerned with the manner of occurrence. The time at which an event will occur, or at which a plan will be fulfilled, is important because of the difficulty of seeing far ahead. The regularity of occurrence will have much to do in determining the distance which can be seen ahead. The number of factors which concur to bring about a certain event are also of great importance, because the more there are of them, the greater difficulty is experienced in planning with accuracy.

A final group of factors is concerned with the interpretation of the statistical components into the finished plan. Here the personal element of judgment plays a leading rôle, and the ability to interpret accurately according to the facts without influence or bias.

Foreseeable Factors.—Foreseeable factors are those which it is in the power of the individual to control,

or which he can insure against because of his knowledge of the frequency of their occurrence. These events may occur naturally, or may be set in motion through some human agency.

In the case of accidents in factories, fires in buildings, and other such occurrences, it is usually possible to predict the frequency of occurrence in industry at large, and even to classify the causes of them numerically. That is, so many painters will die of lead poisoning; so many miners will die through explosions in mines; so many railroad employees will be killed, and the like. Although the individual accident cannot be pointed out, yet the general prediction may be made. This has allowed the formation of employers' liability insurance companies, the success of which is founded on the accurate prevision of the elements of risk in different businesses.

It is the object of every business to obtain the utmost possible control over all the conditions surrounding it. Accordingly, the growth of a progressive concern shows a steady conversion of unforeseeable factors into the class of foreseeable factors. For example, a manufacturing concern starts by selling all its goods through a commission house, and has virtually nothing to say about retail distribution. But it finds it cannot make its plans with any accuracy under such conditions, and, consequently, it gradually assumes the function of retail distribution itself.

Although the successful business shows a gain in control, yet it must always reckon with the possibility of some elements falling back again into the class of unforeseeable factors. A well-organized and law-abid-

ing group of workmen may, within a week, become a band of law-breaking strikers, thereby upsetting every arrangement upon which the firm had banked. It is such emergencies which are the hardest to provide for in any business prediction or plan. The predictor can take care of the external and even the entirely uncontrollable matters by insurance, or he can otherwise protect himself against catastrophes. But it is those matters which are on the border line between the foreseeable and the unforseeable which present the greatest element of uncertainty.

Unforeseeable Factors.—The first class of those indeterminate factors which upset the equilibrium of events consists of influences beyond the control of human action. No one, for instance, can as yet predict the spot where the lightning will strike. A farmer may have every reason to expect large profits from the crops stored in his barn, but this sudden bolt may in one moment annihilate his prospects. Earthquakes, hurricanes, and floods may be classed in the category of those continually recurring phenomena which cannot be foreseen.

"Foreseen," of course, is a word which is constantly shifting in application. Ten years from now, factors which appeared totally unpredictable may be brought within the range of accurate prediction.

The business man may, by insurance or by some other means, shift the element of risk; but this in no manner does away with the risk itself, nor does it bring it any more under his control. He merely pays money to shift the responsibility. That is, he takes on a small but immediate burden in order to avoid

shouldering a far greater burden if a certain remote but possible event should take place.

It is the unforeseeable events which most completely nullify predictions. A company may have every prospect of success until some revolutionary invention, protected by patent, develops its prospects almost over night. There are other examples. Infidelity of a trusted employee may seriously inconvenience a business. The bankruptcy of some large customer or creditor may bring on a financial crisis. Well-managed companies recognize that the risk exists and accordingly accumulate reserve funds to guard against sudden and unlooked-for disaster.

Time.—Time is invariably a factor in every problem of business planning. Generally speaking, the more immediate events are easier to predict in detail, while so many intermediate events are interposed between those which are remote that it is much more difficult to give a detailed prognosis, but much easier to make a general prediction. The exceptions to this statement are mostly astronomical, where the laws are sufficiently well known to permit of accurate prediction far ahead of the actual occurrence.

When the occurrence of an event is to take place at some distance in the future, factors once negligible may grow to much greater proportions. It is possible to give to each factor only the weight which it appears to possess at the time. Long-range weather forecasting, for example, is as yet in the embryo stage. Weather forecasts for the ensuing 24 hours are all that the weather bureau cares to be judged upon, although it does attempt to forecast the weather for a week. But

there are so many small exceptions unnoticed at the time, which may develop in importance, that the results, even for the shorter period, are often inaccurate.

In certain conditions, the element of time is controlling, as in the case of seasonal depressions. Under certain other conditions, the will of a single individual or group of individuals may delay or precipitate an event. The failure of a business, for example, may be delayed by the efforts of one individual to defer the inevitable moment.

As a rule, general tendencies are much easier to predict than particular events, and the more remote the period to which the prediction applies, the more forcibly is this rule in operation. It is like the observer on a vessel approaching a harbor, who makes out the city as a whole before he can distinguish individual buildings.

Motion.—Every plan or prediction must allow for movement, as well as for time. This motion may be rapid or slow, irregular or regular. In the commercial world, many of the curves of regular occurrence have been charted.

The more rhythmic the course of events, the easier it is to make the prediction. In astronomy, the curve is almost absolutely regular, and the predictions are correspondingly accurate. The movements of the stock market partake of a certain regularity, not always discernible at the time, but plainly evident when viewed in the perspective of the past. Knowing the law which such curves follow, it is possible to predict, after a general fashion, what course they are going to take.

Unfortunately, events do not always seem to follow the course prescribed for them by past happenings. That is, history does not always repeat itself, because conditions are never quite the same. It is possible to make new history. In fact, it is impossible not to make it. The past curves may have been caused by the maintenance of an equilibrium which may, in the future, be disturbed. The factors causing this disturbance of equilibrium may sometimes be predicted. The regular movement will be interrupted, but preparations for the new motion may be made by observance of the effects of like disturbances in the past.

Conditional Clauses.—In general, the more "if clauses" there are present in a prediction, the less definite it will be, because there are obviously more chances of something intervening which will subvert the probable effect of the laws operating in the beginning. It becomes, in some instances, impossible to make a prediction on account of the multiplicity of the "if clauses."

Where there are many concurrent and inharmonious factors, a prediction can be made but a short period in advance. As understanding of causes becomes more complete, the time of accurate prediction should be prolonged.

A great many contingencies which may happen to a business are carefully calculated. Insurance is carried against fire and burglary, for example. A company also knows in general fashion about its seasonal variations in sales. A retail store knows to what extent sales will be affected by a mild winter or a rainy summer.

One conditional factor is often so entangled with others that it is difficult to isolate it. Trouble in production means trouble with customers through delayed deliveries and trouble with purchasing because of overaccumulation of materials. One factor is so dependent upon another that, in computing the weight of "if clauses," it may be necessary to make other "if clauses" subordinate to the original ones.

In making up a prediction, the limiting factors should be arranged, first, in the order of their importance, that is, the severity of the effect, and, second, in the order of their frequency of occurrence.

By arranging them in the order of their importance, it is possible to compute the probable extent of damage should such and such an event take place. By arranging them according to frequency, it is apparent at a glance which event is most likely to occur. By comparing the two, it is possible to determine, qualitatively, at least, the degree of risk from all factors combined, as well as that from any one factor.

The Hidden Factor.—In making any prediction or plan, there is always the possibility of the existence of some hidden factor which will nullify the accuracy. By careful planning and the exercise of foresight, however, it is possible to minimize, or at least to allow for, this hidden factor. Yet in nearly every business problem, there is a point beyond which it becomes impossible to provide against the accidental factor. In other words, so long as business men take chances, a large allowance must be made for this hidden element Engineering, considered one of the exact practical sciences, still uses a "factor of safety." The engineer

has two objectives, safety of structure and economy of construction. A generation ago, the importance of the former was exaggerated, and a very large factor of safety was used. It was not at all uncommon to make a bridge with a larger factor of safety than the maximum traffic would require. Since then, the demands of economy have been gradually reducing the factor of safety without in any way impairing the usefulness of the structure.

Ability to predict is in almost direct proportion to the supply of information. If in possession of all the data regarding any particular phenomenon and of the laws which are operative, a process of pure reasoning, called deduction, is used, to foretell results. The process of reasoning which attempts to determine the law which operates from an examination of the results of experience is called induction. In most business predictions, it is desirable to use both the inductive and the deductive methods of reasoning. Induction is used to study the data and from them to frame the law which applies. Deduction allows the making of the prediction on the assumption that the law formulated is applicable.

In business, there is rarely any case in which all the facts are known. It is necessary to be satisfied, therefore, with approximations, and to remember the simple corollary that the more data are possessed, the more accurate the statement of the law will be, and the more reliable the prediction will become.

Personal Factors.—The human element enters into every business prediction, because the accuracy of the prediction is dependent upon the judgment and skill

of the predictor. He must be able to distinguish the essential from the non-essential factors, and to discern shose laws which take precedence, and those which are tubservient. He must make allowances for constantly varying factors and trends.

It is a much debated question whether the will of the individual is subject to his own control, or whether his decisions and choices are predetermined by all his previous experiences, his heredity, and his environment. In business, the policy of the company is often determined by the will of a single individual, or perhaps the consensus of opinion of a board of directors which is largely dominated by a single individual. It is often possible to predict what action this governing board will take by analyzing the character of that individual, upon the theory that a man's choice is determined by his past. It is known how he has decided in the past on similar questions, and whether his views tend towards progressiveness, towards the static, or towards reaction.

In making predictions or plans, it is desirable, of course, to eliminate, in so far as possible, the element of personal bias, and to subject the factors in the prediction to the scrutiny of scientific analysis.

Summary.—From the foregoing discussion, some fairly well-crystallized inferences may be drawn:

1. An accurate prediction is dependent on knowledge of the facts which are pertinent, and the accuracy of the prediction is in direct proportion to the supply of information. The application of prediction to business is difficult because so many factors are unknown, and because so many are unforeseeable or uncontrollable.

2. It is impossible to predict the uncontrollable and unforeseeable factors as applied to the specific case, although it may be possible to shift the risk by means of insurance.

3. The existence of hidden factors makes it desirable to have a certain margin of safety in making predictions.

4. The more conditional factors exist, the less accurate the prediction becomes, because it is difficult to obtain information as to the effect of many forces, while that of a few is often measurable.

5. Any phenomenon which occurred in the past will occur again in the future under similar conditions. Conditions, however, are never exactly the same, and the effect of new factors or changed factors must be measured when using the past as a basis of comparison.

6. The nearer the event is to the time of occurrence, the more accurate the prediction is likely to be, because the unforeseeable factors are fewer and the comparative influences of various causes can be approximately measured. A distant prediction may be accurate in its general terms, but is likely to be wrong in its details, and also as to the exact time of its occurrence.

7. The more rhythmic the course of events, the more accurate the prediction is likely to be. The tides of the ocean, for example, follow a regular and predictable course.

8. The accuracy of the prediction will depend in great measure upon the skill, knowledge, and impartiality of the predictor.

CHAPTER III

SOURCES OF DATA

All prediction is based upon facts. In the last decade, business has been busy gathering and organizing its facts. It is unreasonable, of course, to expect that business can ever become so exact a science as chemistry. All the elements, compounds, mixtures, and reactions concerning which the chemist makes predictions are within his manipulative control, whereas many of the elements and forces to be considered in a business problem are the result of the interaction of thousands of individuals over whom the predictor has no control. Nevertheless, facts collected over a period of years indicate that business forces can be observed and recognized, their characteristic beginnings, developments, and effects can be plotted, and predictions can be made which will assist the business management in making its plans.

Types of Facts.—Various types of facts are used in prediction. In the first place, there are the various statistics of a fundamental nature which are used to determine the general trend of industry, or for correlation with industrial and company figures. In the second place, there are statistics dealing with a particular industry, and finally, there are the many types of company statistics, based on records, observations, experiments, or opinions.

While a great many companies prefer to accept the digests of fundamental statistics prepared by the various forecasting services, other concerns use these data to make their own forecasts.

Statistics pertaining to an industry are practically always necessary in addition to those of a fundamental nature. These are often digested in the form of index numbers.

Data collected or prepared by the company itself are usually of the following types:

1. Data based on company records, accurately recorded over a period of time long enough to be representative.

2. Observations or experiments from which conclusions may be drawn.

3. The securing of opinions with the view to establishing changes in methods of production, marketing, or other phases of business activity.

External Sources of Data.—Data of a primary nature can be obtained from the following sources:

1. Libraries. It is always important to look up anything that has been written or tabulated on the same or similar subjects, because this may save a great deal of wasted effort. Companies possessing their own business libraries should make it a rule to investigate their own files before beginning any investigation or collection of data. In addition to general libraries, a number of special libraries are available from which more specialized information may be secured. Although the movement for tabulating and recording statistical data is merely in its

infancy, already a considerable body of material has been built up.

2. Trade associations. A part of the work of the large trade association is concerned with the gathering of statistics from its members, and the consequent tabulation and presentation in digested form. The National Retail Dry Goods Association, the National Retail Clothier's Association, the Life Insurance Sales Research Bureau, and many others are constantly working along these lines, although much still remains to be done. The trade association is in a particularly advantageous position to collect industrial statistics, because it is the one connecting link between competing members of the industry.

3. Trade journals. There has been an increasing demand on trade journals to have them act as reporters of trade statistics, and in some cases as interpreters of statistics having to do with the trade. As long as these statistics are of a fundamental or industrial nature, and are uninfluenced by advertising considerations, they are valuable. Many publications, however, have become gatherers of market statistics which are furnished upon request to advertisers. Such statistics must be critically examined.

4. Newspapers. Newspapers have been increasingly useful as reporters of business facts, especially because they are usually the first form of publication to make an appearance after the figures become available. The financial newspapers, especially, make a point of reporting statistics at the earliest possible moment.

5. Yearbooks and directories. A great deal of valuable information of a statistical nature is published in the various yearbooks and directories, the only difficulty being that such material gets out of date quite rapidly.

6. Reporting services. In several fields of business activity, it is possible to subscribe for detailed statistical information. In the building trades, for example, the F. W. Dodge Company supplies statistical data. Statistics on securities are published by Poor's and Moody's *Manuals*. The Standard Statistics Bureau also gives statistical information on stocks and bonds.

7. Credit-rating companies. Dun's and Bradstreet's credit agencies both publish magazines containing a great number of statistics of a commercial and financial nature.

8. Federal Reserve banks and other large financial institutions. Each of the 12 Federal Reserve banks publishes a monthly summary of business conditions in its district, which is distributed free of charge. Many banks publish reports of business conditions and statistics at regular intervals.

9. Chambers of commerce. Many chambers of commerce, especially the Chamber of Commerce of the United States, are able to furnish statistics of value to business concerns.

10. Government sources. The government, through its various departments and bureaus, is constantly collecting statistics of all kinds. The main difficulty is that business concerns in general do not know where to get these statistics.

FEDERAL GOVERNMENT

DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS

Cotton Statistics	Monthly
Census of Hides, Skin, and Leather	"
Census of Manufactures	Every 5 years
Census of Industries	" "

Survey of Current Business
Summary of Foreign and Domestic Commerce
Industrial Standards—standard specifications
Special Consular Report Covering Various Countries
Miscellaneous Service Special Agent Service
Commerce Report and Supplement

FEDERAL RESERVE BOARD

Federal Reserve Bulletin	Monthly

FEDERAL TRADE COMMISSION

Newsprint Paper Review	"
Statistical Summary of Paper Industry	"
Wood Pulp Review	"

Various Bulletins, such as
Combed Cotton Yarns
Newsprint Paper Copper

GEOLOGICAL SURVEY

Coal Production	Petroleum Statistics	Weekly
Power Production		Monthly

MINERAL RESOURCES OF THE UNITED STATES

Issued yearly; contains bulletins such as
Copper in 1920 Lead in 1920, etc.

BUREAU OF MINES

Bulletins
Bibliography of Petroleum and Allied Substances
Petroleum Laws of America

TARIFF COMMISSION

Tariff Information Surveys
Various Bulletins Such as
Cotton Yarns
Import and Export Trade in Relation to the Tariff

DEPARTMENT OF AGRICULTURE

Bulletins such as
Classification of American Upland Cotton
Bulletins of the United States Forest Service Such as
Utilization of Lodge Pole Pine Sugar Pine
Slit Leaf Pine, its Economic Importance

TRADE AND OTHER ORGANIZATIONS

A List of These Is Published by the Bureau of Foreign and Domestic Commerce of the Department of Commerce—Miscellaneous Series No. 99.

STATE

Each State has Various Bureaus and Commissions Which Publish Information
Statistical Organizations Financial Agencies
Engineering and Technical Societies
Chamber of Commerce of States and Cities
Railroad Reports and Special Information Obtained From the Publicity Department or Freight Agents of the Railroads
Banks Trade Publications
Colleges Buyers' Guides

FIG. 1.—(*Management Engineering.*)

11. State statistics. Many of the states have well-developed statistical departments which prepare for distribution facts about the state and its industries.

12. City and town records. It may be advisable to obtain local records for business statistics, particularly when computing markets. Property-tax records, income-tax returns, ownership of homes, and other available sets of statistics may be compiled from these local records.

13. Schools and colleges. In recent years, several of the schools and colleges of the country have established departments of business research. They have the advantage of being able to use the students as collectors of original statistics.

14. Radio. Radio broadcasting has served to increase the rapidity with which information of a statistical nature may be given to the public.

Figure 1 shows the various sources used in one particular case.

Company Records.—In addition to outside sources of data, it is essential to collect certain statistics within the organization. If the company maintains a statistical department, the collection of such records will be part of its functions. The actual statistics will pertain to:

1. Accounting and finance. The accounting department will do a great deal of the actual compilation of statistics concerning the company.

2. Purchasing and buying. Careful records should be kept in the purchasing department of quantities of materials bought and price paid. These will later be compared with figures as to production and sales.

3. Production. Volume of production, rate of production, cost of production, and other important sets of statistics should be kept.

4. Sales and markets. These statistics will include volume of sales by totals, by geographical divisions, by products, or by other classifications, value of sales, distribution of sales territories, and others.

Experiments.—In some lines of business activity, experiments are required to establish facts. Experimentation in the company's own laboratories or workrooms is far less expensive than experimenting on the public. For example, before manufacturing in quantity any particular product, exhaustive experiments are made, first, as to practicability of manufacture and, second, as to reception by the market.

Some organizations maintain costly laboratories for experiments, where ideas for the future are worked out. Although the cost of manufacture, the method of production, the cost of competing products, or some market factor may preclude the possibility of present production, it is foreseen that a time may come when prices of raw material will be low enough or methods of manufacture improved enough to permit marketing. When this time comes, the experiments will have all been made and recorded.

While experimentation has one purely statistical side which can be used as the basis of improvement in production or marketing, it is also used for independent research.

Opinions.—In making any forecast of future events, it is often necessary or advisable to obtain opinions,

and to utilize the consensus of the opinions thus obtained.

The value of opinions is especially great in determining trends which have not yet shown any decided effect upon statistical compilations. Because of the delay in recording and making statistics available to the public, it may happen that a trend will gain headway before it actually shows on the charts. A collection of opinions, particularly when chosen from those who know the subject, will show what trends are at work against the established order, and something as to the velocity of these trends.

Opinions are obtained through interviews, questionnaires, or a combination of both methods. Every opinion as to the future is necessarily a prediction. But opinions are not ordinarily founded on a study of all the facts; they are rather impressionistic reflections of the already acquired knowledge or experience of the individual rendering that opinion. Thus there is some risk and difficulty in distinguishing between valid and invalid opinions.

But what anybody thinks is not sufficient in prediction. It is the thought of the particular people credited with knowledge of the subject which counts. In other words, the opinion of authorities is necessary. If any doubt exists as to the authoritativeness, the opinion counts for little. The value of opinions will have to be gaged in each case. The opinion of a housewife upon prepared breakfast foods might be highly desirable in predicting market receptivity for a cereal preparation, but her opinion as to the value of a

certain type of building material would probably be worthless.

Requirements for Facts.—The facts on which any prediction is based, whether opinions, statistical compilations, reports, or records, should fulfill certain requirements:

1. Authenticity. Facts must be based upon truth. Observations must be correct. Sources must be unimpeachable if facts are taken at second hand.

2. Accuracy. The facts upon which a prediction is based should be accurately reported and recorded. Statistical methods used should be such that the result is an accurate picture of the conditions it pretends to portray.

3. Sufficiency. Enough facts should be gathered about any particular point to make it authoritative. For example, in covering a community, it has been determined that 3 per cent of the population is sufficient to give an accurate picture of the whole, for a certain purpose.

4. Representativeness. Facts upon which a prediction are based should be representative of all factors concerned and not merely of one type of them. If, for example, the market for flour is being investigated, it is not enough to pick one section of a city, but a selection should be made from each section, since all alike are consumers of flour. If, however, the market investigations were concerned with Oriental rugs, it might be proper to base the investigation upon a few sections of the city.

5. Treatment of time factors. If the prediction is based upon a set of facts collected over a period of

time, it is essential to see that the time has been long enough to allow for all natural fluctuations, and that constant watch is kept for new factors affecting the accuracy of the prediction.

6. Fluctuations, variations, and errors. In collecting facts, it is necessary to make allowance for all fluctuations, variations, and errors which may occur. Otherwise, the whole prediction may be invalidated.

7. Judgment in selection. So many facts may be available that it sometimes requires the exercise of a high degree of judgment to know which groups to select and which to reject. Only those facts should be taken which directly affect the results.

Fundamental Statistics.—While smaller businesses and many of the larger ones will prefer to take fundamental statistics in the digested form of index numbers, it may happen that a particular business will have some particular connection with a certain set of statistics. Investment and brokerage houses keep close watch on all such statistics because of their effect on stock prices.

Bank clearings or, in their more recent form, check clearings, are ordinarily given a great deal of credence, because they are taken to show the approximate volume of business done throughout the country. In similar fashion, gross receipts of railroads are frequently used as an index of general conditions, since they are supposed to indicate the volume of traffic. Statistics as to unemployment are also of interest to the business man. When unemployment is increasing, he is able to pick and choose his workmen, but in periods of great prosperity, labor is scarce and high.

Fundamental statistics may be divided into those of a strictly financial nature, such as money rates, bank ratios, and the like; those of a speculative nature, such as stock prices; and those of a mercantile nature, such as railroad cars loaded, business failures, and imports and exports. A full treatment of these is given in Smith's "Graphic Statistics in Management."

Commodity Statistics.—Great importance has always been ascribed to statistics relating to production and consumption of commodities. The conditions of particular crops, such as wheat, corn, and cotton, have decided price influences. The price fluctuations of leading commodities are carefully watched, because of the known connection between the prices of raw commodities and finished products, and also the relation between the prices of certain commodities.

A great number of agencies are engaged in reporting commodity statistics. The government publishes very complete reports on the principal agricultural products, while there are also various independent reporting services. The forecasting services, as part of the information given to clients, publish statistics of commodities and probable price trends.

It is customary, in many cases, to reduce commodity statistics to index numbers, so that they can be compared with each other and with fundamental statistics on some common basis.

Statistics of Industries.—In the great industries, copper, steel, wool, cotton, etc., figures are readily available. In fact, some of the productive statistics of these industries are so important as to be ranked as

fundamental and used in barometers. This, for example, is true of the unfilled-tonnage figures of the United States Steel Corporation. In a way, these figures are indicative of conditions in the entire industry because the Steel Corporation's activities are so broad, its manufactured products so diversified, its market so widespread, that it may be taken as a fairly reliable index of the steel industry as a whole.

The leaders in every industry are carefully watched because they are the first, as a rule, to show reaction to any trend. In many industries, of course, no comprehensive figures can be obtained. But in an industry such as steel a great number of statistics can be secured, such as cost of production per ton of steel produced and prices obtained for same, labor figures, transportation charges, etc.

For any company making a prediction, the general industry of which this company forms a part serves as a background for comparison. For example, by comparing the size of the company with the size of the industry as a whole, the relative importance of each can be seen.

CHAPTER IV

FORECASTS OF GENERAL BUSINESS

The state of prosperity or depression which exists in business throughout the country at large necessarily affects every industry, company, customer, and consumer. In other words, the chain of commerce is composed of many links and ramifications. It has been compared to the arterial system of the human body. The main artery is business in general, and the various arterial branches are the different industries, each of which breaks off in various-sized smaller branches, representing the companies, and in turn ramifies into capillaries representing customers. If there is a stoppage in the main stream, that is, in general business conditions, a wave-like reflection of this stoppage follows throughout the entire system, finally reaching the capillaries. Contrariwise, when there is a speeding up of the main arterial flow, this more rapid motion is also passed on through the tributary streams.

General business conditions are a resultant of forces. When everything works in unison, there is prosperity. When there is a division, trouble results. When there is complete disorganization, there is a panic. When general business conditions are sound, they lend morale and tone to the component industries. There is a psychological feeling of confidence. It is often

this psychological factor which proves decisive in determining the general trend of industry, or even the success of a single business.

Conditions as regards general business and even specific industries may be judged in accordance with certain factors which experience has shown exercise a more or less controlling influence over fluctuations, or are so vitally connected with them that a movement in business creates a sympathetic movement in industries.

Development of Business Prediction.—Those who first observed the phenomena connected with the changes in general business conditions were able to detect a rise and fall over a period of years. Although they were unable to make any forecast, they found the general trend of conditions was readily discernible when charted, although the upward or downward curve did not keep a regular course.

They did, however, develop a theory that a chart or diagram could be made which would foretell economic conditions. The earliest observers were inclined to place all their reliance on some specific index in rigid accordance with which future events in the business world took place. Jevons, the noted English economist of the last century, elaborated his famous sun-spot theory. According to his calculations, the spots in the sun had a controlling effect on terrestrial weather conditions, and, by careful observation of these sun spots, a prediction could be made as to general business conditions. His line of reasoning was briefly as follows:

The fundamental basis of prosperity is crops. Man must live on what he raises. If the weather is good,

he will raise a great deal, and, consequently, the price of foodstuffs will be cheap. If food is cheap, then mankind will be well fed and nourished, wages will be high enough to afford a fair amount of luxuries, credits will be good, business will expand, and the world will be prosperous. Conversely, if the sun spots denote a continuance of bad weather, then the crops will fail, food will be high, hardship and poverty will be prevalent, and business will be depressed.

Even if the causal relation of sun spots with weather conditions had been fully established, Jevons failed to take into consideration the other factors which might affect the situation. He fell into the error of predictors who rely on a single index for infallible results. He failed to realize that the condition of crops is but one of many causes which determine business prosperity.

The next great advance in the forecasting of business conditions was made by Benner. He formulated the so-called cast-iron rule, by which one extreme invariably follows another. That is, periods of depression must inevitably be followed at regular intervals by periods of prosperity. This was an important advance over the pioneer work of Jevons. In addition to recognizing that there was a causal connection between certain factors and the business morale, he also noted that a fairly regular course was followed. Where he erred was in supposing that this course was regular and that it governed the causes, that is, that it was like the ocean swell which lifts and falls with clock-like regularity, every third or ninth wave being supposed to be slightly higher than the others.

The modern forecasting idea is founded on the theory that the trend of business conditions is flexible and not fixed, that if the various factors which influence business conditions can be correlated and charted, then a prediction can be made as to the future trend. The main differences of opinion between the various methods of prediction lie in the choice of determining factors.

Forecasting Services.—There are several methods of classifying the various agencies which take fundamental statistics and from them prepare a digest and forecast of business trends. They can be divided on the basis of whether they use the so-called "lag" theory, the "area" theory, or some other theory. The accuracy of results, however, does not depend so much on the theory used as it does upon the analysis and interpretation of the statistics employed in making up the forecast.

The individual business is most concerned with the type of forecast which can be correlated with its own internal statistics, and from the combination a definite plan of business activity mapped out. There are at least three different types of forecasting services:

1. Services which make forecasts for subscribers and receive payment in return. The best-known of these are the Babson's Reports, the Brookmire Forecaster, and the Harvard Economic Service. These organizations are in a position to obtain the most accurate statistics, and to apply the most scientific methods of digesting these statistics and of forecasting the future business trend. Their value to the subscriber, of course, is measured by the degree to which

he can correlate this forecast with his own statistics, and govern his business accordingly. This implies, as well, that the forecasting service should be approximately correct in its prediction of major and minor trends.

2. Forecasts made by trade papers and periodicals as part of their news service, such as those appearing in *System*, the *Annalist*, *Management and Administration*, etc.

3. Forecasts made for publicity and advertising purposes by banks and brokerage houses. Such forecasts are ordinarily financial in nature, and are not based upon such broad statistical foundations as the preceding types.

The Babson, Brookmire, and Harvard systems of forecasting have come into such general use that a brief description of the methods used by each is desirable.

Babson's Business Barometer.—The so-called Babsonchart (see Fig. 2) is based on the area theory, that is, that the fundamental law of action and reaction applies in economics as well as in physics. No equality was found in the degree of expansion and resultant depression in the field of business, however. If the rise was very rapid, this was no indication that the fall would be equally sudden. Babson, therefore, decided to take into account both the intensity and duration of the action and reaction, formulating the theory that the area of activity would be approximately equal to the following area of depression. He believes that the size of this area can be forecast, but that its shape cannot be foretold; that is, knowing the size of the

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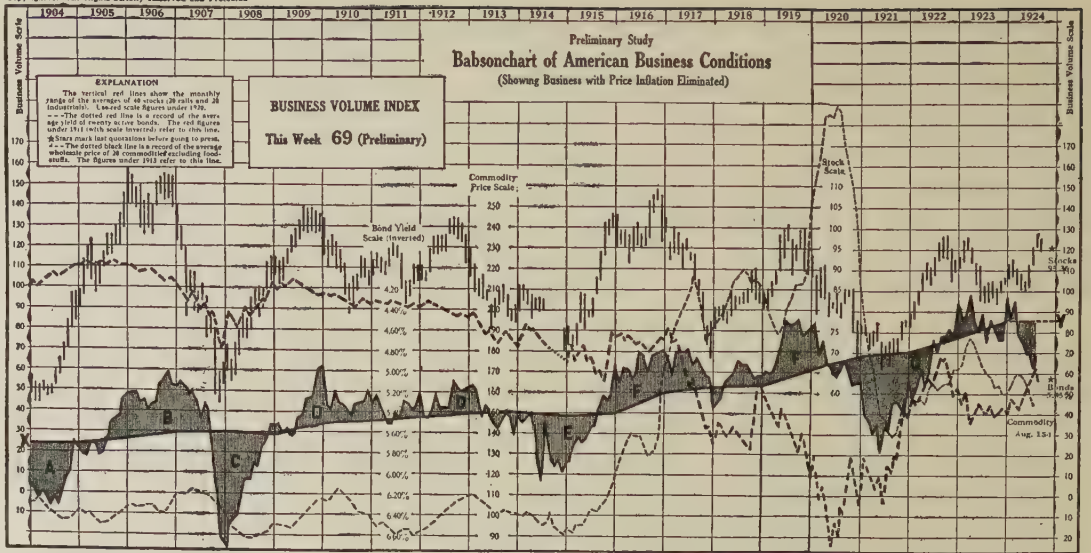


EXPLANATION OF THE DEFLATED BABSONCHART

This study of the Babsonchart, deflated, is based as far as possible on the same subjects which make up the Babsonchart of Business Value. These subjects, treated to eliminate price inflation where depending on dollar values, are as follows: Check Transactions, Failures, Pig Iron Production, New Building, Domestic and Foreign Money Rates, Volume of Foreign Trade, Railroad Earnings and Crops. Stocks (Rails and Industrials), and an Index of Canadian Business Conditions are also included.

The purpose is to represent the volume of transactions, irrespective of any change in the general price level thruout the period, i.e., the volume of business expressed in physical units. Because of the difference in retail and wholesale price movements since 1913, we have used since that date a weighted price index in which both wholesale and retail price changes have been considered.

Business Failures and the Volume of Foreign Trade, expressed in dollars, are corrected by Bradstreet's Index of Wholesale Prices thru 1913 and by our weighted price index since that date. The proportion of price movement which will be reflected in Bank Clearings (or Check Transactions) has been estimated at 75%. Check Transactions (Bank Clearings before 1919) in this plot are therefore corrected by the weighted index adjusted to show three-quarters of the actual price movement. New Building, expressed as value of permits, has been corrected by the average of Babson's Building Materials Indices. Railroad Earnings are deflated to correspond with changes in railroad rates.

The same scale tables are used for the various subjects as in the Babsonchart of Business Value. The X-Y Line is located in the same way as in that Babsonchart, except that it is corrected to eliminate the effect of price changes. The line X-Y represents the country's net gain or growth. Based on the economic theory that "action and reaction are equal" when the two factors of time and intensity are multiplied to form an area, the sums of the areas above and below said line X-Y must, over sufficiently long periods of time, be equal, provided enough subjects are included and properly weighted.

In our office studies each area is divided into halves by a narrow white line. This is to emphasize the fact that the first halves of Areas A, C and E are really reactions from the extravagance, inefficiency and corruption which existed during the latter half of the preceding "overexpansion" area. Contrariwise, the first halves of Areas B, D and F are really based upon the economy, industry and righteousness developed during the hard times just preceding. These lines are not drawn on the areas of overexpansion until those areas are completed, but are drawn on each depression area when said area equals one-half of the preceding area of overexpansion.

Further details as to how the Babsonchart is compiled and the X-Y Line located will be sent to any one on application. Questions are always welcomed.

FIG. 2.

preceding area, then the size of the following area will be approximately the same, but it is impossible to say whether the rise or fall will be excessive and of brief duration, or whether it will be prolonged over an indefinite period.

All forecasting services are founded upon various sets of statistics which show a vital connection with the course of business conditions. These statistics must be reduced to a common denominator, known as an index figure. Babson divides the 12 sets of statistics which he uses as follows:

1. Mercantile conditions:
   a. Failures.
   b. New building.
   c. Immigration.
   d. Check transactions (bank clearings prior to Jan. 1, 1919).
2. Monetary conditions:
   a. Commodity prices.
   b. Total foreign trade.
   c. Foreign money rates.
   d. Domestic money rates.
3. Investment conditions:
   a. Crops (corn, wheat, and cotton).
   b. Railroad earnings.
   c. Canadian conditions (included because of direct influence of Canadian business conditions upon the United States; based upon bank clearings, failures, immigration, money rates, volume of foreign trade, crops, commodity prices, share prices, railroad earnings, and new building).
   d. Stock market conditions (20 railroads and 20 industrials).

The index number of each of these three groups is combined into a single barometer figure, and charted weekly on the Babsonchart (see Fig. 2). The so-called *X-Y* line divides the areas of activity from those of depression, and represents the country's net gain or growth. It forms the base line against which statistics are compared. The preliminary position of the *X-Y* line is based on trend of check transaction and later corrected to fit the actual facts. This *X-Y* line is supposed to show the approximate rate at which business can be carried on without activity and depression.

In addition to the general business barometer, reports are made on various phases of the business situation, such as credits, and conditions are summed up in individual industries.

The Brookmire Barometer.—The lag theory of forecasting is based on the observation that certain factors in the business cycle occur comparatively early, while others lag behind. In other words, as soon as certain conditions are observed, the forecast can be made that other conditions will follow within a certain time.

The Brookmire forecast is based on three sets of statistics:

1. Mathematical composite of six fundamental factors, each weighted according to the influence it has had in past business changes:
   - *a.* Stock prices (combination of railroad and industrial).
   - *b.* Physical volume of commodities coming into the market, using composite of eight different measures of physical volume.

Barometer Number I --- Industrial Stocks and Commodity Prices

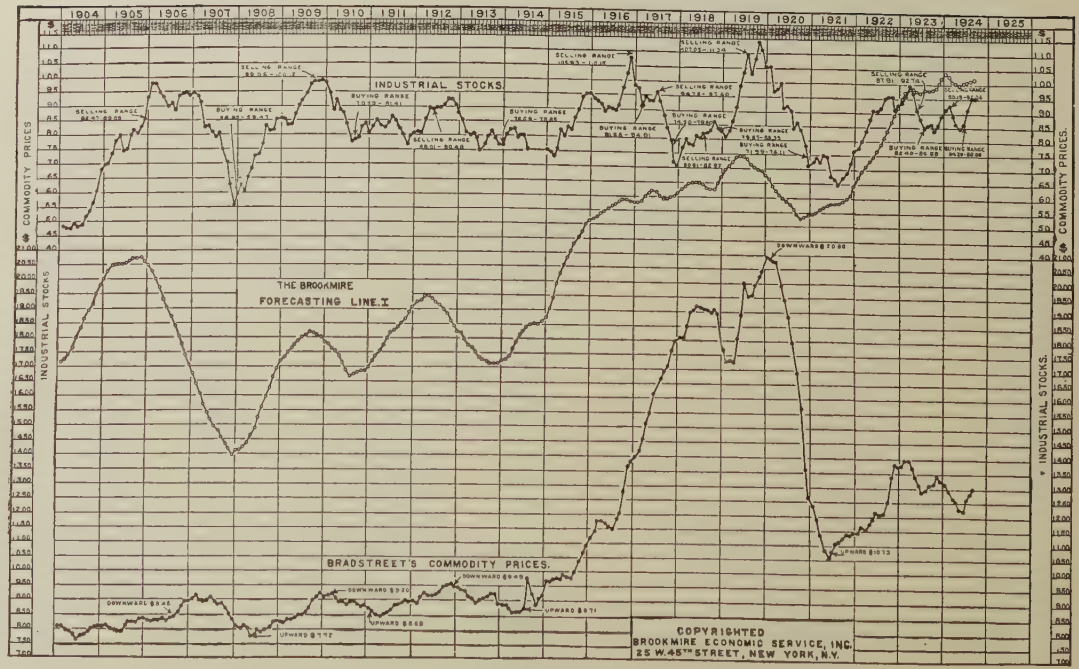


FIG. 3.

c. Ratio of merchandise imports to exports.
d. Standard of living, measured by turnover of bank deposits.
e. Commercial-paper rate.
f. Three months' open-market rate in London.

2. Average of 20 industrial stocks, used in correlation with the composite of fundamental factors. That is, the movement of stocks is forecast by the graph of fundamental conditions.

3. Bradstreet's index of commodity prices. By experiment during the past 16 years, it has been found that the upward or downward turn of Bradstreet's index of commodity prices averaged 6 months later than the turn in industrial stock prices.

Figure 3 illustrates the Brookmire Barometer.

Harvard Economic Service.—After a period of severe testing, the forecasting service of the Harvard University Committee on Economic Research was begun in 1919. Like the Brookmire system, it is based on the lag theory, or a definite series of relationships existing between the curves of speculation, business, and banking. These three sets of statistics are made up as follows:

1. Speculation:
   a. New York City bank debits.
   b. Price of industrial stocks.
2. Business activity:
   a. Bank debits for 140 cities outside New York City.
   b. Cyclical index of commodity prices.
3. Money rates:
   a. Rate on 4 to 6 months' good commercial paper.
   b. Rate on 4 to 6 months' prime commercial paper.

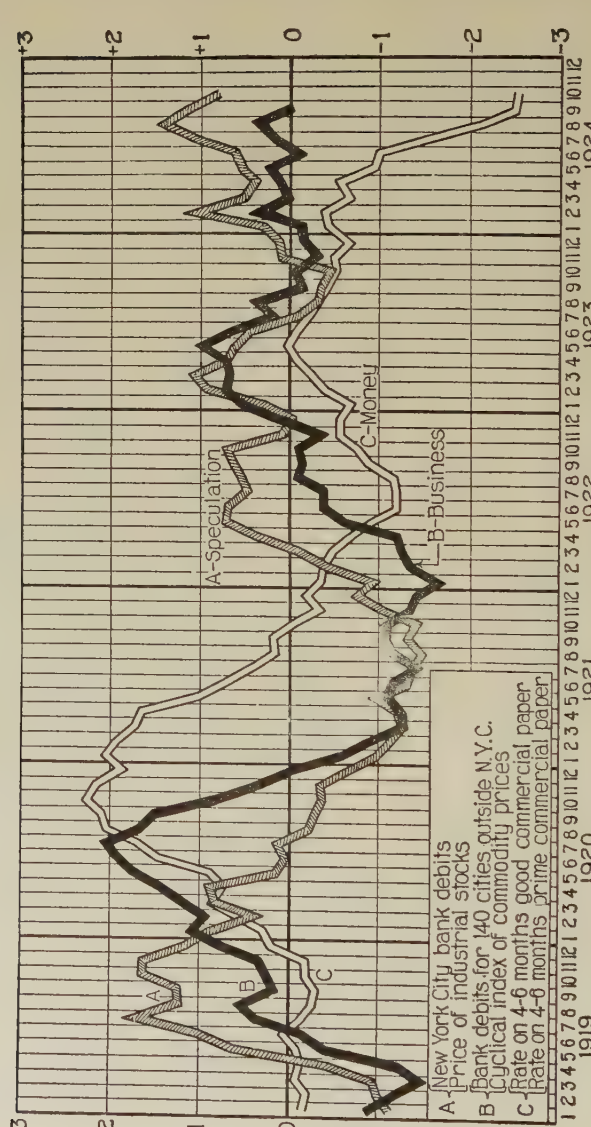


FIG. 4.—(*Harvard Economic Service.*)

Figure 4 shows the method of charting these three curves. To quote from the pamphlet explaining the method:

> It is evident that there is an interval of several months between the movements of each of the three curves. It is further clear that the turning points of the curves whether upward or downward, always come in the same order. The turning points in curve *A*, speculation, precede by 8 to 12 months the turning points in curve *B*, reflecting wholesale commodity prices, and similarly the turning points in curve *B* precede the movement of curve *C*, reflecting money rates and banking conditions, by 2 to 8 months.

The subscriber to the Harvard service receives a weekly letter on the general economic situation, two letters a month dealing with general business and financial conditions (including a forecast), and the other two letters dealing with important phases of the current economic situation. There is also a quarterly review of economic statistics, and special statistical supplements.

Value of Forecasting Services.—The attitude of business men towards the various forecasting services is almost identical with their previous reactions toward efficiency engineering and cost accounting. One section of them is inclined to believe that business forecasting is purely empirical, has no uniformity of method, and is no better than the old rule-of-thumb methods. Another section is inclined to embrace business forecasting as a universal panacea for business ills.

Needless to say, both these views are incorrect. Business forecasting is a new science. As yet, it is largely confined to the formation of general barometers, which cannot be used in any one business as a special barometer without careful correlation. In the majority of businesses, the factors which determine the correlation have not been thoroughly worked out. The forecasting barometer, therefore, should be used as a guide to show the general direction of activity.

The present forecasting services have to be translated by the business man into action. It is at this point that the individual ability of the business man enters. He uses the forecasting services as tools with which to work in formulating his judgments, and finds himself in a much better position than his rival who relies merely upon his own experience.

The forecasting services were originally contrived to help the investor. But, as Babson points out, the investor does not have to enter the market until he wishes. That is, he can use the forecasts or wait until some other time. The business man, however, must make forecasts every day, and act upon them. He cannot remain passive. He should, therefore, use the best methods of predicting available. If he is not in a position to obtain data from his own organization, it will repay him many times over to utilize one of the forecasting services, and to correlate it with his own activities.

Forecasts by Periodicals.—A number of periodicals have, in addition to reporting statistics, undertaken the formation of industrial barometers. The value of such a service to subscribers is, of course, dependent

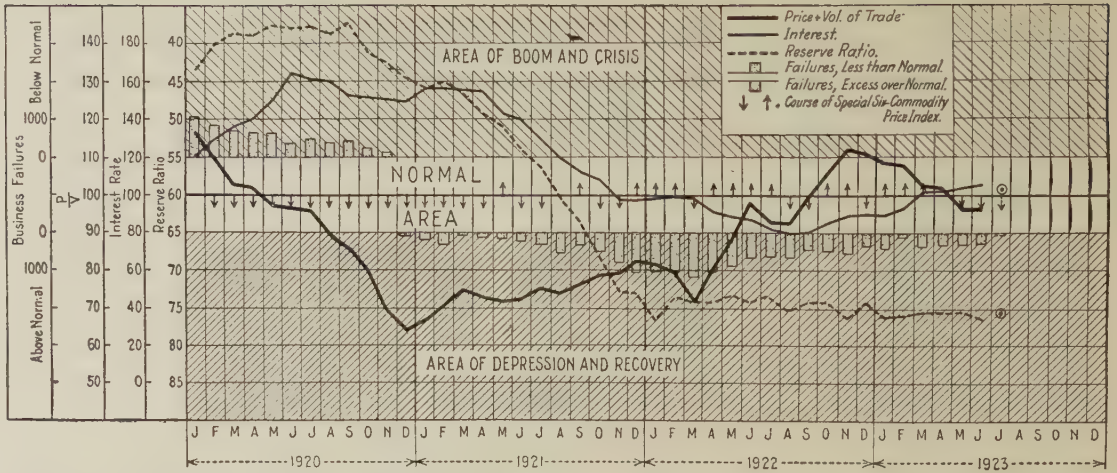

Price × Vol. of Trade
Interest
Reserve Ratio
Failures, Less than Normal
Failures, Excess over Normal
Course of Special Six-Commodity Price Index
AREA OF BOOM AND CRISIS
NORMAL AREA
AREA OF DEPRESSION AND RECOVERY
Business Failures
Above Normal
Below Normal
P/V
Interest Rate
Reserve Ratio
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1920
1921
1922
1923

FIG. 5.—The barometer of industry and trade. Indications point to a period or recovery. Areas in which curves lie indicate that business is good, normal, or poor, respectively. Curve P/V shows the trend of demand, and is the ratio between Bradstreet's index of wholesale prices and physical volume of trade (carloadings times tons per car), based on 1912 as the normal year. A rise in the curve indicates increasing demand, and vice versa. The P/V curve has been corrected for seasonal variation from January, 1923 on. Interest rate curve has been corrected for seasonal variation, and index number 100 equals 5 per cent. Federal reserve ratio of cash reserves to note and deposit liabilities is inverted to harmonize its indications with the rest of the curves. Business failure bars are based on Dun's reports, and "normal" equals the trend for 40 years. Six-commodity price index based on N. Y. U. Bureau special investigation. July, 1923 data shown is probable trend. (*Management and Administration.*)

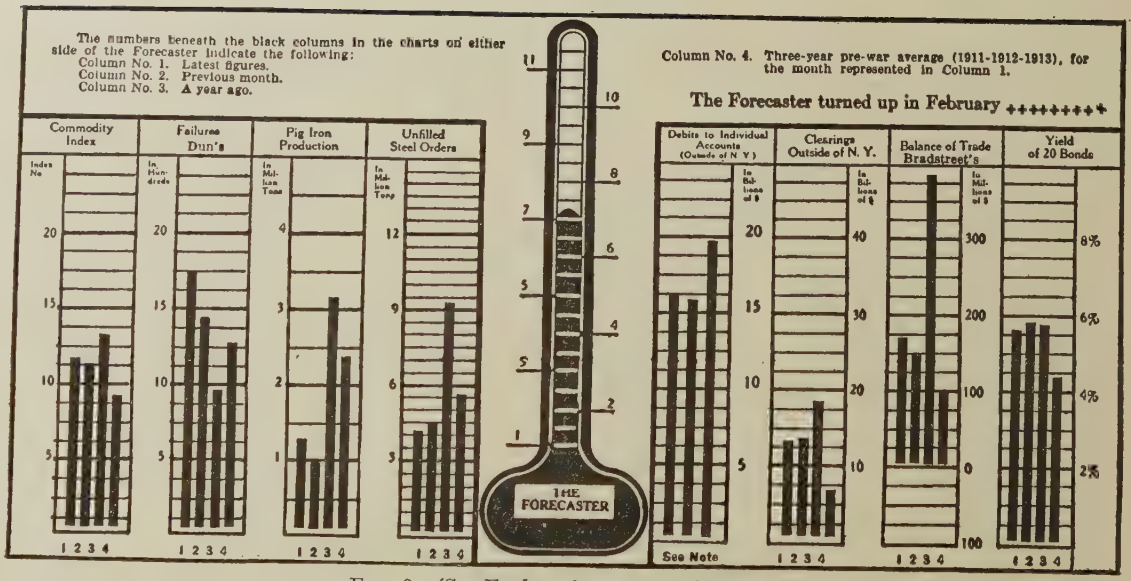

The numbers beneath the black columns in the charts on either side of the Forecaster indicate the following:
Column No. 1. Latest figures.
Column No. 2. Previous month.
Column No. 3. A year ago.
Column No. 4. Three-year pre-war average (1911-1912-1913), for the month represented in Column 1.
The Forecaster turned up in February
Commodity Index
Failures Dun's
Pig Iron Production
Unfilled Steel Orders
Debits to Individual Accounts (Outside of N. Y.)
Clearings Outside of N. Y.
Balance of Trade Bradstreet's
Yield of 20 Bonds
THE FORECASTER
See Note
1 2 3 4

FIG. 6. (See Explanation on opposite page.)

FIG. 6.—When the red fluid in the Forecaster turns in an opposite direction from what it has been going, it forecasts that the price of an average of twenty Standard Bonds as they are quoted thirty days after the turn will be a safe selling range if the Forecaster is declining or a buying range if the Forecaster is advancing. Furthermore, if the Forecaster continues to move in any one direction for four consecutive months it indicates that a turn in our commodity index in the direction that the Forecaster is moving, can be expected in seven months from the date of the first turn of the Forecaster.

The month that the Forecaster turns will be printed in the upper right hand box of the chart and a plus sign will follow representing each month that the Forecaster advances, or a minus sign for each month that the Forecaster drops.

Commodity Index: November figures an increase registered, the fifth consecutive movement in this direction.

Failures (Dun's): October figures an increase registered, liability figures unattainable at this writing. The movement is a seasonal one.

Pig Iron Production: October figures an increase registered, another indicator of the soundness of our Forecaster.

Unfilled Steel Orders: November figures a decline registered, has little meaning at this time since the decline is largely due to the anticipation of lower freight rates.

Debits to Individual Accounts: October figures an increase registered, continues to be an indicator of sound business outlook.

Clearings Outside of New York: October figures an increase registered, a further indication of the fundamental worth of our Forecaster.

Balance of Trade (Bradstreet's): Note in the above chart quotation last year runs off the register, should read 417,165,000. October figures an increase registered, while most of the fluctuations in this factor are meaningless we feel this one at this time is in keeping with the promises of our Forecaster.

Yield of Twenty Bonds: November figures a decrease registered, a movement which still indicates the progress of business and its progress in this direction monthly signals the investor to quickly complete his accumulations. (*Citizens' National Bank*, Los Angeles.)

upon the accuracy of the predictions. There is also the question of whether such forecasts can be received sufficiently soon to be of use, since they are not available until the publication of the periodical.

The barometer of industry and trade, prepared by Lewis H. Haney of the New York University Bureau of Business Research, and published by *Management and Administration*, is particularly interesting (see Fig. 5). The chart is divided into three areas, indicating, respectively, whether business is good, normal, or poor. The heavy black line indicates the trend of demand, and is the ratio between Bradstreet's index of wholesale prices and physical volume of trade (carloadings times tons per car) based on 1912 as the normal year. In addition to this, the chart shows the interest-rate curve, the Federal Reserve ratio of cash reserves to note and deposit liabilities, business failures based on Dun's reports, and a six-commodity price index based on the New York University Bureau special investigation.

The final form of business forecast is that made by banks and other institutions. While brokers often publish letters to customers outlining business conditions, these are based, of course, entirely upon the probable effect upon the stock market. The various members of the Federal Reserve system, however, publish monthly bulletins of business conditions without making any attempt at scientific prediction. Some of the larger individual banks prepare elaborate forecasts, such as is illustrated in Fig. 6. Here the Citizens National Bank of Los Angeles, Cal., uses eight sets of statistics to prepare its forecaster.

CHAPTER V

THE BUSINESS CYCLE

Whether or not any individual believes in the necessity for periodic peaks and slumps in business, the so-called business cycle is a statistical fact, and as such must be reckoned with in making plans and predictions. It is not necessary, of course, to treat it as a fetish, as is done in some cases. The aim of every business, however, is to act before the extremes of prosperity and depression occur, and to find some means of determining this moment with approximate accuracy. For this purpose, the business cycle has a definite value.

Such large concerns as the American Radiator Company, the Dennison Manufacturing Company, and the American Telephone and Telegraph Company, to mention only a few, are working out methods of correlating their business operations with the business cycle. How far the business cycle may be applied to any particular business cannot be told until the attempt has been made. In making a trial, it is not sufficient to read books on the subject, or to subscribe to forecasting services, and to leave the matter there. Such expense is of little utility unless all the statistics and facts obtained in such ways are digested and applied to the business in hand.

In making any constructive plans for stabilizing production and for preparing for periods of depression or prosperity, it is essential to distinguish between temporary and permanent demand. When orders come in with ever-increasing rapidity, it is natural to suppose that the increase is permanent, while as a matter of fact it may be artificial. A knowledge of the business cycle will help to determine this point.

Change in Price, Not Volume.—It was once almost generally believed that volume of trade during a depression was much less than during a period of prosperity. Careful research has shown the fallacy underlying this belief. The apparent superiority of sales during peak periods is due to valuation in dollars and to speculation. When it comes to measuring the actual consumption, in pounds, gallons, or yards, economists have calculated that there is little if any difference between periods of prosperity or depression. Such computations, of course, are exceedingly difficult to make, and are open to error, but the conclusions seem to be fairly well supported.

For example, the department stores in the Federal Reserve districts sold more goods during 1921 than during 1920. That is, volume of trade was greater during the period of worst depression. The same was true of the largest wholesale establishments in the New York district. Measured in dollars, of course, there is a great difference, but this is accountable purely to the shrinkage in values and in prices rather than in volume.

Even in the case of manufacturing activity, the results are not always what have been supposed. The

production of many raw materials shows no diminution during periods of depression, because people must eat, wear clothing, and use their automobiles.

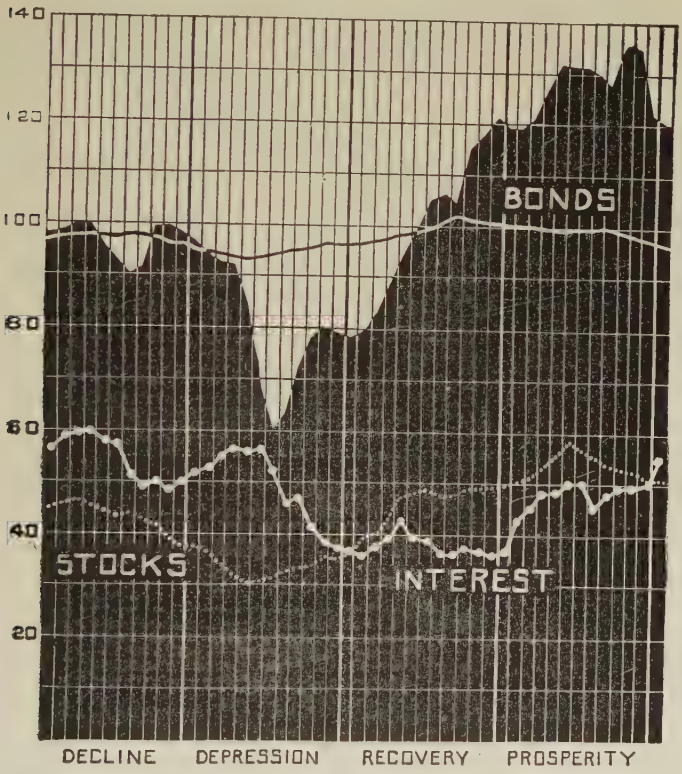


FIG. 7.—A typical period of depression and recovery, based on the data of four actual periods. (*L. P. Ayres, Cleveland Trust Company*, Cleveland, Ohio.)

None the less, there is a definite and often predictable swing in such items as pig-iron production, and in the rate of building construction. On the other

hand, for many of the so-called business barometers, the changes are due more to appearance than reality. For example, the great volume of bank clearings during a period of prosperity is largely due to speculation.

Phases of the Business Cycle.—The business cycle is divided into either four or five phases. The four-phase theory groups the movements of the cycle according to decline, depression, recovery, and prosperity. Figure 7 illustrates a typical four-phase period of depression and recovery, based on the data of four actual periods. Each of these phases is distinguished by certain characteristics, which are fairly well recognizable, and which serve to identify the particular position in the cycle.

The division into five phases, used by the Harvard Committee on Economic Research, calls for periods of depression, recovery, business prosperity, financial strain, and industrial crisis. Figure 8 shows the five-phase division for three business cycles, tabulating the salient features of each phase and the time in months occupied during each cycle.

The Period of Depression.—The low point of the business cycle is distinguished by the small volume of speculation, little business activity, lowering of commercial-paper rates, and increase in bank reserves. Commodity prices at this time are at their lowest ebb. The banks, which have hitherto been in a difficult credit position, now find themselves with large quantities of money on hand, which they can put into high-grade securities.

The actual business depression is accompanied by a mental depression which makes it difficult to secure

VARIOUS PHASES OF THE BUSINESS CYCLES, 1903–14

PHASE	Nov.–Dec. 1903 to Nov.–Dec. 1907	Jan.–Feb. 1908 to July–Aug. 1910	Sept.–Oct. 1910 to Nov.–Dec. 1913
	Months	Months	Months
Phase I: Depression	10	6	10
(*a*) Security prices begin to advance; speculative activity increases.			
(*b*) Commodity prices continue to decline; business activity is sluggish.			
(*c*) Rates on commercial paper decline; bank reserves increase.			
Phase II: Recovery	18	14	12
(*a*) Speculative activity is marked.			
(*b*) Business activity recovers; commodity prices begin to advance.			
(*c*) Rates on commercial paper begin to advance late in this phase of the cycle.			
Phase III: Business Prosperity	10	4	8
(*a*) Speculative activity is checked.			
(*b*) Business activity and commodity prices continue to increase.			
(*c*) Rates on commercial paper continue to advance while bank reserves decrease.			
Phase IV: Financial Strain	10	4	4
(*a*) Security prices decline sharply; speculative activity is depressed.			
(*b*) The upward tendency of business activity and commodity prices is checked.			
(*c*) Rates on commercial paper remain high or stiffen and the banking situation is strained.			
Phase V: Industrial Crisis	2	4	6
(*a*) Prices of securities reach bottom and speculative markets are panicky.			
(*b*) Commodities are liquidated, prices fall, and business activity slumps badly.			
(*c*) Rates on commercial paper reach maximum and bank reserves reach minimum. The crisis breaks.			
Length of complete cycle	50	32	40

FIG. 8.—(*Harvard Bureau of Business Research.*)

orders, even though prices are at extremely low levels. Failures are common, particularly among those concerns which had large inventories at the time of the crisis and were unable to dispose of them at a profit or without an exceptionally heavy loss.

Business men in the past have rarely been in a position to take advantage of the opportunities offered by the period of depression. Those few who have advocated making heavy purchases at this time have been mere voices crying in the wilderness of mental despondency which has surrounded them. The course of action which is rapidly being recognized as best is the liquidation of stocks as rapidly as possible before the crisis actually occurs and immediately thereafter, so that the firm will be in a position to buy raw materials at bargain prices and manufacture at a profit while other concerns are still endeavoring to clear their decks for action. The same method holds true for the retailer who can clear out his stocks in anticipation of the new range of prices.

The question of new developments should come to the fore at the period of depression. When planning for building or other material improvements, it is particularly important to take into consideration all the factors affecting business conditions, and to study the long-range trend of the business. Expansion, unfortunately, comes most often in answer to the artificially increased demand during the period of expansion. Improvements are undertaken, only to be carried out under conditions of highest prices, and are available for use many times only when prices have fallen and demand is practically non-existent.

For example, during the 1921 depression, many manufacturers found themselves ready to produce more at a time when everything demanded curtailment of production.

The Period of Recovery.—The second phase in the business cycle marks a change from a general feeling of pessimism to a sentiment of confidence in the future. The activity in the stock market increases, and stocks begin to show substantial gains. Commodity prices, instead of showing little or no activity, begin to move more briskly, and at increased prices. Manufacturing concerns find orders coming in at an increased rate. Profits, both gross and net, show monthly increases.

During such a time as this, the company is gradually called upon to put forth all its resources, both productive and credit. Sales, on the other hand, come easily, so easily that it is often termed a "sellers' market."

The transition, of course, from a period of depression to one of recovery is not immediate, nor does it take place in all lines at the same time. In the raw materials it is noticed first, and gradually spreads until it reaches the retail lines, to be reflected last in wages and rents.

Many people think that a forecast of the modern business cycle should give an opportunity for profitable speculation. This is not the business point of view, however. Buying raw materials in quantities which the company will use is not speculation when statistics and barometers forecast a rise in prices. It is merely legitimate preparation for business which is reasonably certain to come. The efficient purchasing agent will be prepared to exercise his knowledge of business

conditions to make sure that his supplies of raw material are sufficient. When the general outlook is for increased business, he can increase his holdings without fear of loss, and when the outlook grows clouded, he can reduce his inventory. The same holds true of the other activities of business.

The Period of Prosperity.—The growing demand evidenced by the public gradually brings a change from the period of recovery to that of prosperity. With the withdrawal of money from more or less speculative ventures for legitimate needs of business, the money rates begin to rise. Business concerns find themselves in need of additional capital to take care of their increased business, and during the period of prosperity, such needs are eagerly taken care of by the investing public.

The psychological aspect at this time is of extreme confidence, in many cases bordering on overconfidence. The feeling of caution which has arisen during the last major crisis begins to give way before the apparently stable basis of present business conditions. Wages rise, and there is a shortage of help in certain lines. Many new ventures are started which, at the beginning, are able to make satisfactory profits, but which are operating with high overhead.

It is at this point that the prediction of general business conditions should act as a check to overenthusiasm. It should be possible to tell approximately how far the phase of prosperity has progressed, so that full advantage can be taken of it, while preparations are being made at the same time for the lean period ahead.

Some retail stores have found it profitable to avoid excessive inventory at any time, and to base their prices on a certain percentage over cost. This allows them to make a profit regardless of the business cycle, because when any change occurs, they are in a position to buy at the new rate and sell also at a profit. While gains may not be so great during a period of rising prices, they are able to weather the storm better when the depression finally sets in. Other stores, however, are compelled to maintain large inventories in order to have complete stocks. Here the utility of studying the business cycle is at once apparent.

One important point to remember is that there is a period of financial strain or tension during which the business man will have warning that there is to be a change. Conditions must be ripe before some particular event will start the ball rolling.

Peak and Crisis.—The increased confidence in business prosperity gathers momentum with rapidity. The new enterprises in the field are able to compete with old-established firms only because of the era of high prices. Capital is rapidly becoming scarce and there is much credit tension. Commodity prices by this time have reached high levels. Stocks prices, however, have already started to fall. Any event may dislodge the economic structure from its false position of security. Many banks are in a weakened position because they have extended loans on the basis of inflated values.

It is during the final days of a period of prosperity that the business man must exercise the greatest caution so that he can reduce his rate of production and

clear out his inventories before liquidation becomes so advanced that he must sacrifice his stocks at a profit and run his factory at a loss. It is when factories are running at their highest point that the time comes to make preparations for the dull period.

Another indication that the period of prosperity is nearing its end is when wages and materials have advanced so high that profits begin to fall off. This diminution in profits and the high interest rate cause the prices of stocks to cease advancing, and then to start downwards. The banks begin to feel the stringency and to call the loans. This reacts on business firms which begin to demand payments of accounts. Failures become numerous and prices of stocks take great drops because of forced selling.

It is symptomatic that public confidence reaches its high point after actual conditions show that the decline has set in. But this does not mean that business men should be equally blind. They have, on the contrary, a sufficient body of data at their disposal to show when this danger point is at hand, and that it is time to prepare for the future.

One point to note is that financial provision should be made for the period of depression while it is easy to secure money. New improvements should not be started at the end of a boom because they will have to be carried out at peak prices, and become available when there is no demand to make their use profitable.

Application of Business Cycle.—Regardless of the nature of the business cycle, or any of its aspects which economists are unable to agree upon, it is

almost universally agreed that it has certain well-defined effects upon:

1. Purchasing.
2. Production.
3. Sales.
4. Finance.
5. Personnel.
6. Miscellaneous activities.

1. Purchasing. From the point of view of purchasing, the position of the business cycle is of the greatest importance. Prices of raw materials fluctuate over a great range, often because purchasing is not correlated with potential sales. For example, a purchasing agent buys steadily ahead during a rising market. But he does not know when to stop. He finds himself making more and more paper profits on his purchases, and accordingly extends himself more. Production apparently keeps pace proportionately with him. But suddenly he finds himself in the midst of a depression, and not only have his profits gone, but he finds himself with an overbalanced inventory, and production fallen off almost to nothing. By paying careful attention to the business cycle, he should be able to tell when it is advisable to reduce inventory and to prepare in advance for the slump in production.

2. Production. It is not sufficient to have production keep pace with current demand, because demand by such a plan would be always getting ahead or falling behind production. The proper method is to make advance plans to see what the probable demand will be. One of the factors in this demand is the position

in the business cycle, and the relative position of the particular company in relation to other industries. By such a method, it will know when to speed up production to take care of coming demand, and when to reduce inventories in advance of a dull spell.

3. Sales. During the period of prosperity, there is a so-called "sellers' market," when salesmanship plays a relatively unimportant part in comparison to the ability to make delivery, price of product, and similar factors. When a depression sets in, salesmanship is at a premium, because it is difficult to induce people to buy, and the market is known as a "buyers' market." During the upward trend, markets come almost without seeking; during the downward path, markets must be sought after and carefully exploited.

4. Finance. At one time, it was comparatively rare for a company to make special financial arrangements for lean periods when credit was to be had only on exorbitant terms. It is still rather the exception than the rule. But the trend is steadily towards a budgeted financial program which will look ahead beyond the immediate needs of the company.

5. Personnel. Another branch of the company's activities where it has only recently been recognized how important it is to make advance provision is that of the personnel department. During a period of prosperity, there is great demand for men in all departments of the business, and the less effectual workers find full-time employment with a consequent slowing up of production. During depressions, the less efficient workers are promptly dismissed, and the production per capita increases. By carefully watch-

ing the business cycle, some concerns find themselves able to build up a permanent force, and to avoid the great expense contingent upon the periodic hiring and firing of workers. They keep a nucleus of a force to build upon. Where little skill is required for manufacturing operations, it has often been advisable to let the entire force go. Where much skill is required, the important men should be kept. Another method of solution often employed is to keep the entire force on half-time work rather than to reduce the entire force one-half.

6. Miscellaneous problems. The business cycle has an effect upon almost every branch of the company's activities. The credit policy, for example, is directly affected. During a depression, even good accounts inevitably become slow. Therefore, as soon as the advent of a depression is noted, the collection policy should aim to follow up collections quickly. Similarly, credits should be limited to sure risks. Some companies during a time of prosperity have more business than they can handle and try to restrict their credit granting to companies which they are sure will pay promptly.

It is often a mistake, however, to restrict credits too closely during a time of depression, because it is at this time that orders are needed most, and long-term credits, provided the risk is sound, may prove beneficial as a business-getter.

Another phase of company activity which is greatly affected is that of advertising. There is a variety of opinion as to whether it is better to direct the greatest advertising effort during times of prosperity when

sales are easy or during times of depression when sales are difficult.

The solution of all these problems is directly dependent upon the ability of the company to apply the business cycle to its own activities. The next chapters indicate the various steps which it is necessary to take in order to coordinate the external and internal factors of business.

CHAPTER VI

STATISTICAL ANALYSIS

After statistics have been gathered, it is necessary to subject them to careful analysis. As mere columns of figures, they are practically useless. They must be collected, arranged, classified, tabulated, and brought into connection with other statistics before they become of value.

Statistics are of particular utility where causal relations are not thoroughly understood. It might seem that if the circumstances under which a certain event occurs are so complex as to defy analysis, or if the event itself cannot be separated into its elements, it would be impossible to make reliable generalizations about it. Statistical analysis, however, often proves otherwise.

The theory of statistics is that if the concurrence of two phenomena is merely a coincidence, then the frequency of occurrence in one should make no difference in the occurrence of the other, and, conversely, if there is a correlation, there must be some causal relation. Thus, if the number of fires in a community is greater where gas is used for illumination than where electricity is employed, there is a causal relation between the illuminating agent and the number of fires.

Even though the causal relations are not thoroughly understood, they may be turned to profit by the use of statistics. For example, the number of people passing in and out of a railroad station may be a factor in determining whether it is profitable to obtain the right to operate a cigar, newspaper, and magazine business in that vicinity. A certain statistical relationship has been observed and turned into profit.

The Norm.—There are certain business problems concerning which practically all the facts necessary for prediction are known. There are others concerning which knowledge is so meagre as to make prediction uncertain or even impossible. The majority of business problems lie between these two extremes, and require a method of attack which is a compromise between the two methods described. Ordinary business predictions, accordingly, involve the application of general laws to specific cases and, in addition, an examination of the specific cases themselves in the light of their intrinsic peculiarities.

Thus, in making predictions, there is a constant comparison of the average with the exceptional. The term "average" is an ideal or hypothetical state which in actual practice is rarely encountered and may also be referred to as the "norm." Since almost every case is in some measure exceptional, one of the first tasks in prediction is to find the norm, and then to measure the deviation from it.

The norm is found by applying the law of probabilistie. That is, in a million cases, a particular event will occur a given number of times, depending upon

the number of eventualities. For example, a report is made of the number of failures in a certain line of business. Knowing the total number of concerns in the business, and having computed the number of failures in years past, it is possible to measure the deviation from the norm.

Application of Probability.—The laws of probability show that even guesses may be made logically. Life insurance is the great example of the application of mathematical principles to a business venture. The principles are, however, always the same.

When a coin is flipped, it is just as likely to fall "head" as to fall "tail," but it must fall one way or the other. The probability that it will fall "head" is 1 (the number of possible ways it can fall "head") to 2 (the total number of ways it can fall). The probability is expressed mathematically as ½. After two trials have been made, it does not, however, follow that one was "head" and the other "tail." The probability of falling head will be more nearly realized as the number of trials is increased.

When the term "probability" is used, it means that the result is uncertain. If nothing is known about an event, the probability of its occurrence is ½, as in the case of the flipped coin, because it is just as likely to happen as not to happen. If there is a conviction that the event must happen, the probability is 1; if a conviction that it will not happen, the probability is 0. The conviction will depend upon the extent of knowledge of facts in the case.

In the case of the flipped coin, if its exact position at the instant the impulse was given were known,

together with the strength of the impulse, the way gravity and air resistance affect the motion, the nature of the ground where the coin strikes, the laws governing the collision between a coin and the ground, and perhaps a dozen additional factors, then it would be possible to determine whether the coin would fall "head" or "tail."

In the majority of cases, there are more than two occurrences which may take place. If there are five possibilities, then the probability of the occurrence of any one is $\frac{1}{5}$, assuming that there is equal likelihood that each way take place; and since one of the events must occur, the total probability is $\frac{5}{5}$ or 1. The probability that the particular event will not occur is $\frac{4}{5}$. Similarly, if the probability of the occurrence of an event is $\frac{3}{7}$, the probability of its failure to occur is $\frac{4}{7}$. The odds in favor of the occurrence are 3 to 4, and the odds against the occurrence are 4 to 3.

Application of Theory of Probability.—Calculations made according to the theory of probability are reliable only when very large aggregates are involved. The remarkable relations discovered by mathematicians in their study of the laws of probability are, however, sufficiently remarkable. Suppose, for example, that a merchant whose fortune amounts to $100,000 knows that he will realize $50,000 more if a certain vessel arrives safely, but he knows also that the probability of its safe arrival is only $\frac{4}{5}$. That is, under the existing conditions, an average of one such ship out of five is lost. An insurance company will then be entitled to one-fifth of $50,000, or $10,000, to compensate it exactly for the risk it takes in underwriting. It has been proved mathematically that the probable

value of the merchant's total fortune, if he does not insure, is $138,320. The probable value of his treasure in the uninsured vessel is only $38,320, which is $11,680 less than the amount he will realize if it arrives safely. He can, therefore, afford to pay the insurance company as much as $11,680. If the company charges him only $10,680 for carrying the risk, he gains $1,000, and the company earns $680, and both parties to the agreement benefit from the transaction.

It has also been proved that if the merchant had his $50,000 divided among five ships, the total probable value of the treasure would be more than $40,000. That is, if the probability of safe arrival is $\frac{4}{5}$, then at least $40,000 may be expected to arrive safely.

The first serious examination of statistical data was made by insurance companies, and the tremendous expansion of business done by them is due to the fact that their calculations have been found to be nearly 100 per cent correct.

There is no lack, however, of the application of purely statistical data in everyday business. A person who contemplates opening a restaurant in a particular section of the town may calculate the probability that a certain number of those who habitually pass the place may be induced to enter. He might, for example, determine the actual number of passersby at different hours of the day and different days of the week. He might also tabulate the number entering nearby stores, or working in the neighborhood, and similar facts. He would then be in a better position to judge the possibilities of making money by opening a

restaurant and also the type of restaurant which would be best adapted to the locality.

The Use of Averages.—In the analysis and examination of statistics, averages are widely used. Several different types may be employed, the particular type being dependent on the statistics themselves and the desired result.

1. The arithmetic average. The most common form of average is obtained by adding together the various quantities to be averaged and dividing their sum by the number of quantities. The arithmetic average of 5, 8, 9, 10, and 13 is found by adding these numbers together and dividing the sum, 45, by 5, leaving the average as 9. The principal difficulty with this ordinary form of average is that any particularly large numbers, or any particularly small numbers, may make the result not representative. This danger becomes smaller as the number of figures used increases.

2. The weighted average. The weighted average is a modification of the arithmetic average, and allows greater emphasis to be given to the more important factors and less to the less important. Suppose, for example, that a number of pebbles are collected. It is found that they can be divided into five groups, the members of each group having approximately the same weight, such as 5 ounces for the first group, and 8, 9, 10, and 13 ounces, respectively, for the other groups. There are, however, 7 pebbles in the first group, 35 in the second, 30 in the third, 20 in the fourth and 8 in the fifth, that is, 100 in all. The arithmetic average would be found by adding the weights of the 100

pebbles and then dividing the total by 100. The weighted average is found more readily as follows:

$$\frac{5 \times 7 + 8 \times 35 + 9 \times 30 + 10 \times 20 + 13 \times 8}{100}$$

or

$$\frac{35 + 280 + 270 + 200 + 104}{100}$$

or

$$\frac{889}{100} \text{ or } 8.89 \text{ ounces.}$$

Thus, the groups of greater size are given greater weight. A familiar application of the weighted average is the formation of an index number for the change of prices, made by fitting suitable weights to various commodities in accordance with their relative importance.

3. The mode. The mode is a form of average which automatically discards extremes. It is the quantity which occurs with the greatest frequency. The "average man" or the "average business" is usually the mode rather than the arithmetic average. In a series of numbers such as 1, 2, 3, 4, 4, 4, 3, 2, 1, the mode would be 4, while the arithmetic average would be much less. There may, of course, be several modes in a given series of numbers.

4. The median. The median is the middle quantity in a series. It is found simply by arranging items in the order of their magnitude and taking the one which occupies the central position. The median of 7, 15, 30, 40, 43, 50, 90 would be 40. The advantage of the median is that it may be employed in dealing with quantities for which no accurate measurements can be obtained.

5. The geometric average. The geometric, or logarithmic, mean or average is a quantity which can be substituted for each of the quantities when they are multiplied together and give the same product, whereas the arithmetic mean is one which can be substituted for each of them when they are added together.

All these types of averages are used chiefly as bases of comparison, the choice of the average being made according to the accuracy with which the deviation from the normal may be measured. The aim in all statistical interpretation is to digest the figures in assimilable form while presenting a true picture of the facts.

The Index Number.—The term "index" means something which indicates. An index number should accordingly indicate some important aspect of a situation In this sense, there are a number of standard index numbers, such as bank clearings, business failures, unemployment, interest rates. That is, the failure-index numbers enable one to state definitely that at one period there are more failures than usual, and the credit man will exercise greater discrimination in the granting of credit during a period when the index of failures is high than when it is low.

Often, however, an index number is used to measure fluctuations in the composite price of a large number of commodities. Such an index number is usually considered more important than any other because it clearly has some relation to general business conditions and can be correlated with the company's own statistics. The value of such a commodity index

depends upon how representative the commodities are, and how accurately the data entering into it were compiled.

Preparing a Commodity-index Number.—The purpose of a commodity index is to render a true picture of facts. It can do this because the composite of a number of related factors will present a truer picture than any one. That is, fluctuations influencing one commodity will not be reflected by the group unless such a fluctuation is universal. The larger the number of commodities entering into the composite, the greater is the likelihood that it will be a good index.

1. The choice of units. The process of selecting suitable units is especially important. Evidently, the price of 1 ton of steel, 1 pound of sugar, 1 pound of cotton, and 1 pound of tea, if averaged, would be unduly colored by those commodities of which the prices were relatively high, and even a wide fluctuation in sugar or cotton would be invisible in the average. It is apparent, therefore, that some "weight" should be attached to each unit to give it its proper importance in the index. It is also evident that some commodities are much more important than others, measured by production. If 500 million tons of steel and 1,500 million bushels of wheat were harvested during a certain year, the composite should contain 3 bushels of wheat to 1 ton of steel.

2. The price. The ordinary method of choosing the price is to take an average of the wholesale prices of the commodity in the principal markets. The same thing can be done with retail prices, although the differences are greater and the results not usually so

satisfactory. The purpose is to observe fluctuations in price and not the prices themselves.

The first point in making up an index is to select the quantities and to set down the price per unit. For example, in Table I, 18 commodities are set down with their price on a certain date.

Table I

Commodity	Unit	Price
Wheat	1 bu.	$1.265
Corn	1 bu.	0.6875
Oats	1 bu.	0.460
Flour	1 bbl.	7.75
Coffee	1 lb.	0.09
Sugar	1 lb.	0.052
Butter	1 lb.	0.445
Eggs	1 doz.	0.60
Lard	100 lb.	9.40
Pork	100 lb.	25
Beef	100 lb.	16
Iron	1 ton	23.50
Steel	1 ton	29.
Copper	100 lb.	13.75
Lead	100 lb.	4.80
Tin	100 lb.	31.75
Cotton	100 lb.	18.10
Print cloth	1 lb.	0.0575

The next thing is to select a number which will make each particular commodity comparable with the whole and with each other. The unit chosen for wheat, for example, will be one-tenth of the average wholesale price; for eggs, it will be the actual price per dozen; for steel, one-two hundredth of the

price per ton, etc. The result will work out as in Table II.

TABLE II

Commodity	Unit	Price	Unit chosen	Weighted price
Wheat	1 bu.	$ 1.265	1/10	$0.1265
Corn	1 bu.	0.6875	0	
Oats	1 bu.	0.460	1/10	0.0460
Flour	1 bbl.	7.75	1/40	0.1888
Coffee	1 lb.	0.09	1	0.0900
Sugar	1 lb.	0.052	2	0.1040
Eggs	1 doz.	0.60	1	0.6000
Butter	1 lb.	0.445	1	0.4450
Lard	100 lb.	9.40	1/100	0.0940
Pork	100 lb.	25	1/100	0.2500
Beef	100 lb.	16	1/100	0.1600
Iron	1 ton	23.50	1/200	0.1175
Steel	1 ton	29	1/200	0.1450
Copper	100 lb.	13.75	1/100	0.1375
Lead	100 lb.	4.80	1/100	0.0480
Tin	100 lb.	31.75	1/500	0.0318
Cotton	100 lb.	18.10	1/100	0.1810
Total commodity composite	.....	.....	....	$2.7651

Use of Commodity Indexes.—Commodity indexes are valuable indicators of the purchasing power of money. By taking some supposedly normal year as a base, it can be seen how many "normal" dollars had to be paid for commodities in other years.

It is sometimes important to figure the reciprocal of the commodity index, because this will show how many cents the purchasing value of the normal dollar had during any year. Thus, in figuring the volume of

sales for any organization by their value, they can be measured not in terms of the number of dollars for which the sales were made, but in terms of the "normal" number of dollars. That is, the volume of sales for each period is converted into normal dollars before comparisons with other periods are made. This is readily done by dividing the actual sales by the commodity-index number, or by multiplying the actual sales by the reciprocal-index number.

Any table which is incomplete in detail may be amplified by assuming that the change from one period to the next was not abrupt and that the increase or decrease progressed gradually and steadily. Thus, if the commodity index increased 18.6 from January to April, it can be assumed that the increase was gradual at the rate of 6.2 per month. This is called interpolating and is sufficiently accurate to serve the statistical purpose.

CHAPTER VII

GRAPHIC INTERPRETATION

The compilation of data is important, but the value of the data is enhanced many times when they are presented in a form which simplifies interpretation. Graphic presentation of statistical tabulations is practically obligatory for purposes of prediction and planning. In the preparation of the graphic chart, computations must be made which are sometimes difficult, but the chart itself emphasizes relations between the data which the numbers do not disclose. Even a casual glance at a chart will be rewarded by relations which would be brought to light only by a thorough examination of the numerical data.

Purposes of Graphic Charts.—The interpretation of statistical tabulations by means of graphs will depend, in many cases, upon the purpose for which the chart is made. For example, if vividness of impression is desired, the pictorial or cartoon form of chart can be employed, which sacrifices the ability to compare and correlate with exactness to the striking effect upon the observer. In making predictions or in formulating plans where accuracy of interpretation is subordinate in importance to vividness of effect, such a chart might be useful.

Vividness of impression may also be obtained in other ways. The use of color, for instance, will bring

out relationships and differences with good effect, no matter what type of chart is used. Increasing the normal size of the chart will also serve to create emphasis. Making one line heavier than others in a line chart will call special attention to it.

Graphic interpretation derives much of its importance from the factor of simplicity which it introduces into statistics. Large numbers in long series are difficult to understand, particularly as regards their relation to each other and to different sets of statistics. Management requires essentials rather than details. It also wants to spend as little time as possible in comprehending these fundamentals. Hence, any method, such as graphics, which will reduce details to essentials and present them in pictorial fashion, is not only convenient but indispensable.

The moment figures are properly charted, the relationship between the various groups becomes visible, provided, of course, that such a relationship exists. By charting them over a period of time, various trends become apparent. That is, it can be readily seen just when fluctuations of various kinds take place, and how seriously they affect the normal course of business. The normal growth of the business will also be shown.

When sets of statistics are reduced to a common basis and then charted, it is possible to measure relationships between them. A single company, for example, can compare its sales with the total sales of the industry, and can immediately perceive whether it is increasing its share of the total business, or whether its growth is due only to natural increase.

The Graphic Plan.—Like practically all other phases of business, charting calls for systematic attention. If there is a statistical department, it will take charge of making up the charts. If not, some individual should be given the responsibility and should see that the charts which are agreed upon as essential should be prepared and submitted to executives. As a considerable amount of labor is necessary to keep charts up to date, it is not desirable to have more than are essential to bring out the fundamental facts required for intelligent management. The first rule, therefore, for making graphs, is to prepare only those that are necessary.

Charts may be made up daily, weekly, monthly, every 3 or 6 months, or annually. The frequency with which they are prepared depends a great deal upon the rapidity with which the elements entering into the chart fluctuate. A daily chart of production would be important for the foreman but not of such great importance to the executive as the weekly chart. Daily charts would have to be carefully correlated with similar charts for other years for full value to be obtained.

Weekly charts are often used in picturing production, sales, or purchases. It is customary to have a 4 weeks' moving average line to overcome any unusual fluctuations, and to show the normal or average accomplishment.

Monthly charts are, perhaps, in the widest usage, because of the custom of making up statistics each month. Such charts can compare the figures for the same month for several years past, and can be corre-

lated with a 12 months' moving average. When correlated with fundamental statistics, the probable trend may be measured.

Charts made up at longer periods, while they show trends more plainly, lose much of their importance because the business man has to wait too long for them, and the chance of correlating his business according to these trends is slight.

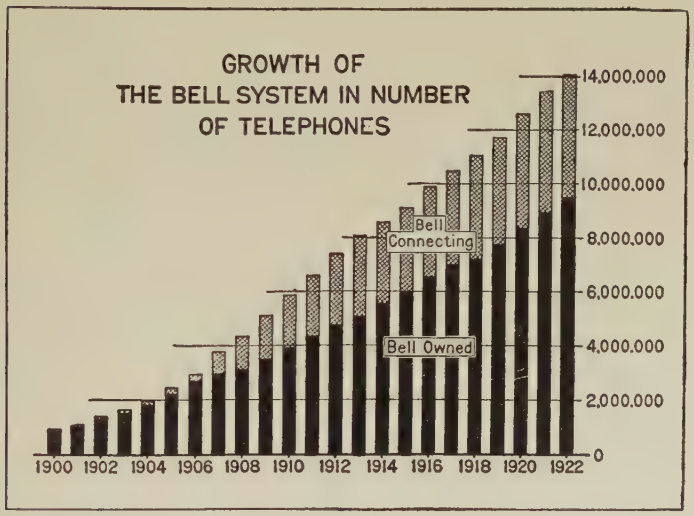
Care should be taken to see that charts are made up the moment figures are available. They should then be sent at once to the executives interested.

If charts are made up in a standard size, such as 8½ by 11 inches, they can be inserted in binders, and kept in perfect condition ready for instant reference. It is also desirable to standardize the scale used in charting as far as possible, so that one chart will be comparable with another.

Types of Charts.—The following types of charts are used for graphic interpretation. The best description as to how to make them can be found in Smith's "Graphic Statistics in Management."

1. Pictorial or cartoon type. Everyone is more or less familiar with the popular methods of presenting data designed to attract the attention of the reader. Ships of various sizes to indicate the relative tonnage of marine traffic of different nations, or of the same nation for different periods; men of various sizes to indicate the relative size of armies; blocks of various sizes to indicate the increase in building operations, and the like. For purposes of prediction, such pictograms are more picturesque than useful, since their chief merit is vividness of impression.

2. Circle or pie charts. Circle or pie charts are also chiefly valuable for their pictorial qualities. A circle for example, is divided into sections to show how every dollar collected by the government is distributed. While it attracts the eye, it does not allow of any accurate comparison between the component



WITH THE 600,000 BELL TELEPHONES ADDED YEARLY, THERE IS PROVIDED A CORRESPONDING INCREASE OF BUILDINGS, SWITCHBOARDS, UNDER GROUND CONDUITS AND CABLES, AND OTHER PLANT

FIG. 9.—(*Bell Telephone and Telegraph Company.*)

parts, because of the difficulty of comparing areas. It is much easier to compare the length of lines.

3. Bar charts. The bar chart has a wide number of uses, particularly where the facts to be charted are comparatively few in number. It may also be used in the Gantt form as a progress chart, as described later on. The bar chart is ordinarily more emphatic

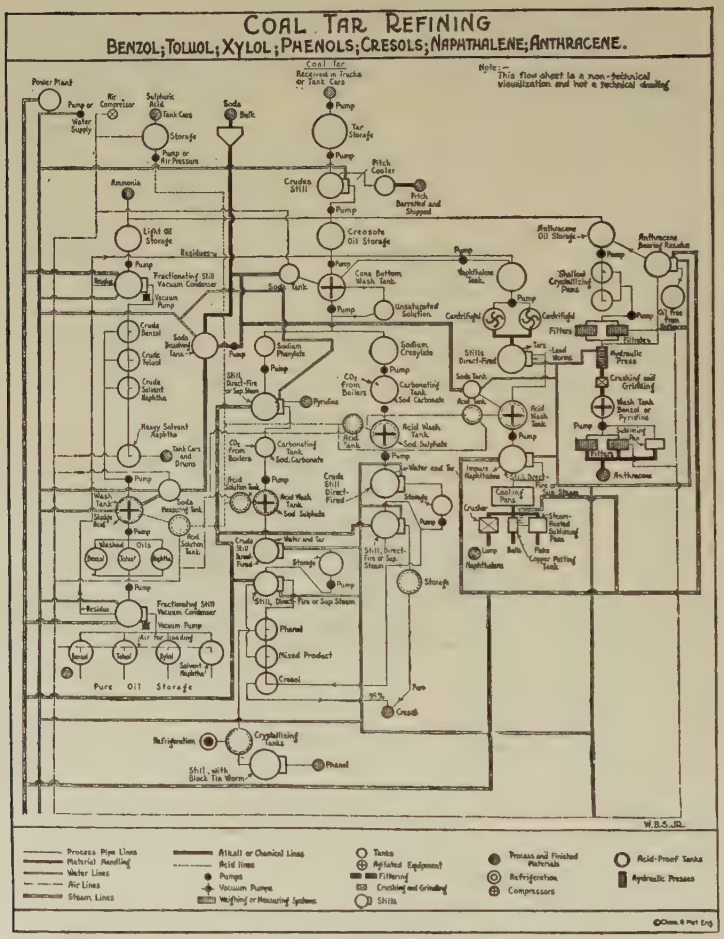


FIG. 10.—(*Chemical and Metallurgical Engineering.*)

than the line chart (see Fig. 9) but has not the same flexibility.

4. Line charts. Statistical data for prediction or planning are best studied from line charts. There are a number of types for specific purposes such as the Z-chart, so-called from the ordinary shape of the three curves composing the chart; the logarithmic or semi-logarithmic chart which shows percentage of increase or decrease; and others.

5. Organization and flow charts. For certain purposes, it is desirable to plot data in graphic form, even though no comparisons or correlations are possible. The organization chart, for example, has become practically universal. Figure 10 shows how the flow chart can be adapted to showing the steps in coal-tar refining. Such a graphic statement of fact is a condition precedent to making plans for improvement.

Rules for Graphic Presentation.—The Joint Committee on Standards for Graphic Presentation, of the American Society of Mechanical Engineers, has prepared the following simple standards for graphic procedure:

1. The general arrangement of a diagram should proceed from left to right.

2. Where possible, represent quantities by linear magnitudes, as areas or volumes are more likely to be misinterpreted.

3. For a curve, the vertical scale, whenever practicable, should be so selected that the zero line will appear on the diagram.

4. If the zero line of the vertical scale will not normally appear on the curve diagram, the zero line

should be shown by the use of a horizontal break in the diagram.

5. The zero lines of the scales for a curve should be sharply distinguished from the other coordinate lines.

6. For curves having a scale representing percentages, it is usually desirable to emphasize in some distinctive way the 100 per cent line or other line used as a basis of comparison.

7. When the scale of a diagram refers to dates, and the period represented is not a complete unit, it is better not to emphasize the first and last ordinates, since such a diagram does not represent the beginning or end of the time.

8. When curves are drawn on logarithmic coordinates, the limiting lines of the diagram should each be at some power of 10 on the logarithmic scales.

9. It is advisable not to show any more coordinate lines than necessary to guide the eye in reading the diagram.

10. The curve line of a diagram should be sharply distinguished from the ruling.

11. In curves representing a series of observations, it is advisable, whenever possible, to indicate clearly on the diagram all the points representing the separate observations.

12. The horizontal scale for curves should usually read from left to right and the vertical scale from bottom to top.

13. Figures for the scales of a diagram should be placed at the left and at the bottom or along the respective axes.

14. It is often desirable to include in the diagram the numerical data or formulae represented.

15. If numerical data are not included in the diagram, it is desirable to give the data in tabular form accompanying the diagram.

16. All lettering and all figures on a diagram should be so placed as to be as easily read from the base as from the bottom, or from the right-hand edge of the diagram as from the bottom.

17. The title of a diagram should be made as clear and complete as possible. Subtitles or descriptions should be added if necessary to insure clearness.

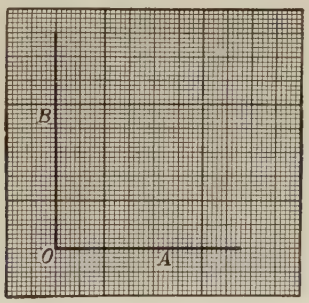


FIG. 11.—Quadrille-ruled paper showing every fifth line more distinctly. Every twentieth line is emphasized still more.

Plotting Data.—In general, ordinary quadrille-ruled or square-ruled paper is best adapted for the study of statistical data, although occasionally logarithmic-ruled paper is found useful. Square-ruled paper merely has horizontal lines at regular intervals, crossed by vertical lines separated by the same intervals, so that two consecutive horizontals and two consecutive

verticals form a square. In the more expensive papers, such as Fig. 11, every fifth or every tenth line is emphasized, thereby relieving the eye which is subjected to less strain if there are occasional heavy lines to guide it than if the lines are uniform.

Any two crossing lines such as *OA* and *OB* of Fig. 11 are selected as "axes," and the related data to be studied are measured along these axes by a suitable choice of units. Whenever time is an element associated with changes in the data, the horizontal axis, *OA*, is usually designated the "time axis."

In charting the sales of a company, for example, suppose the following figures represent monthly sales:

January	$ 41,000
February	70,000
March	97,000
April	105,000
May	97,000
June	105,000
July	64,000
August	51,000
September	62,000
October	21,000
November	55,000
December	35,000

These data are plotted in Fig. 12. Here *OX* is the time axis. One space along this axis represents a month, the end of each division being marked with the initial letter of the month. Thus *OJ* represents the month of January, *JF* the month of February, etc. *OY* is taken as the sales axis, each space representing $20,000. A dot, such as *a*, is the graphic representa-

tion of the statement that the sales for the month of January (counting to J on the time axis) amounted to $41,000 (counting vertically at the rate of $20,000 for each space). The dot b is the graphic representation of the statement that the sales for February (JF) amounted to $70,000. The same is true for the other dots.

The irregular line running through a, b, c, d, etc.. presents a more vivid picture of the variations in the

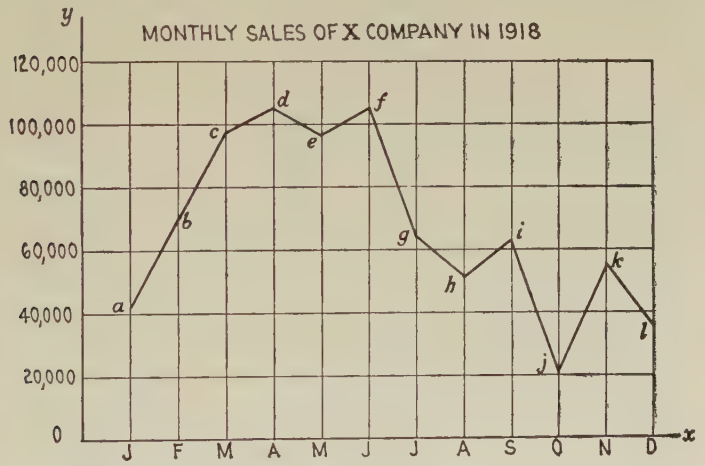


Fig. 12.

monthly sales during the year than the impression given by the figures. It appears that the sales increased rapidly to the end of March, that the high level then reached was practically maintained to the end of June, that during July and August there was a rapid drop followed by some recovery in September, and so on to the end of the year.

Correction Factors.—In making up Fig. 12, a little consideration will show that a number of important factors were not taken into consideration. In the first place, no account was taken of the fact that every month did not have the same number of selling days,

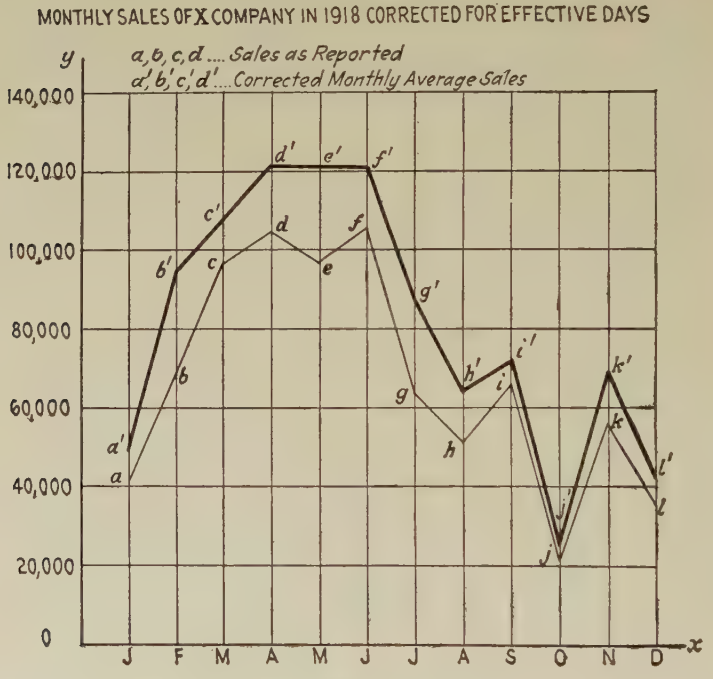


Fig. 13.

and in the second place, that the money value of the sales depends upon the quantity of goods sold and also upon the market prices at which they were sold.

Any conclusions drawn from this chart (and from the numerical data also) are based upon the assump-

tions that the number of working days was the same for each month and that prices remained unchanged throughout the year.

To apply a correction factor for the number of working days in the different months, the number of effective working days in each month can be tabulated, and from this can be calculated an average daily sale and a volume of sales for each month based upon a month of 30 days.

SALES BY MONTHS FOR 1918

Month	Sales reported	Effective days	Daily average*	Corrected monthly average†
January	41,000	25	1,640	49,000
February	70,000	22	3,180	95,000
March	97,000	27	3,590	108,000
April	105,000	26	4,040	121,000
May	97,000	24	4,040	121,000
June	105,000	26	4,040	121,000
July	64,000	22	2,950	87,000
August	51,000	24	2,130	64,000
September	62,000	26	2,380	71,000
October	21,000	25	840	25,000
November	55,000	24	2,290	69,000
December	35,000	25	1,400	42,000

* To the nearest $10.
† To the nearest $1,000.

A graphic chart showing corrected monthly average sales may be superimposed on Fig. 12 by disregarding the irregular line which represents the sales as reported, and finding new positions for the dots, *a*, *b*, *c*, *d*, etc. The result of the correction is shown in Fig. 13, the new data being marked *a'*, *b'*, *c'*, etc. It is to be noted

that the corrected line of average sales is not so irregular as the line of reported sales.

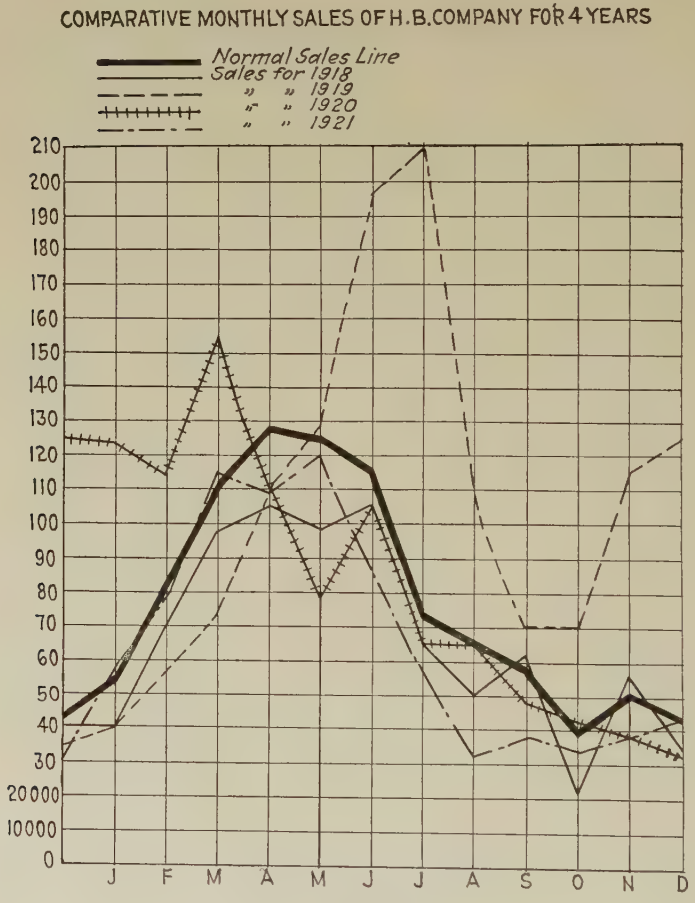


Fig. 14.

Comparisons.—By charting monthly sales for a number of years on the same chart, comparisons may

be made of sales during any one year with sales during other years. For comparative purposes, it is not so important to consider the number of effective days, because the number of effective days in April of one year is not likely to differ from the number of effective days in April of another year.

A chart of comparative monthly sales for 4 years is shown in Fig. 14, using the following statistics:

Month	1918 sales	1919 sales	1920 sales	1921 sales
January	41,000	41,000	123,000	57,000
February	70,000	56,000	114,000	78,000
March	97,000	72,000	153,000	114,000
April	105,000	110,000	113,000	108,000
May	97,000	127,000	77,000	120,000
June	105,000	196,000	104,000	86,000
July	64,000	208,000	65,000	56,000
August	51,000	106,000	65,000	33,000
September	62,000	70,000	47,000	38,000
October	21,000	69,000	42,000	34,000
November	55,000	115,000	37,000	38,000
December	35,000	124,000	33,000	44,000

At first the lines appear confused, and there seems to be little relation between them. A more careful examination shows that sales conditions were abnormal from May, 1919 to June, 1920. If the abnormal parts are excluded, the remaining lines behave in a remarkably consistent manner. In fact, price fluctuations during the latter part of 1919 and the early part of 1920 were violent, and there is justification for excluding the abnormal lines. From the remaining lines, it is possible to construct an ideal line, which varies the least possible from each of those

remaining. This ideal line may be termed the "normal sales line" of the company.

Since the beginning point of the 1922 sales line must begin at the level where the 1921 line ended, a basis is established for charting the sales for 1922.

Sales Expectations.—In making a prediction of sales for the coming year, a line can be drawn paralleling the normal sales line, and from the chart the following table of sales expectations can be made up:

SALE EXPECTATIONS FOR 1922

January	54,700	July	72,600
February	81,000	August	59,500
March	111,800	September	58,300
April	128,500	October	38,000
May	125,000	November	51,000
June	116,600	December	43,700

Ordinarily, the volume of sales will be influenced by a number of factors, such as additions to invested capital, extensive advertising campaigns, special demand created by introducing particularly attractive articles, etc. The curve of fundamental business conditions must also be considered, as discussed in a later chapter on correlation.

Any long-range prediction should never be considered as final, but should be corrected as monthly sales are determined. This, also, is treated in a later chapter.

Index Numbers.—Instead of using the number of dollars in each month's sales, some month, whether real or ideal, may be taken as a standard, and the sales for that month may be indicated by 100 per cent,

or simply by 100. All the other numbers are then converted into percentages of this standard. Thus, if $100,000 is taken as the standard 100, then monthly sales will be represented by percentages of this number, which will be known as index numbers. The sales line then drawn is called an "index line."

The index line does not differ in any way from the sales line previously drawn, because in Fig. 14 the scale of dollars on the left of the figure would be replaced by a scale of percentages, and the percentage numbers would correspond exactly to the number of dollars; thus, $57,000 would be replaced by 57 per cent; $69,000 by 69 per cent, etc.

Index numbers are of great value in making comparisons. Suppose, for example, that the monthly sales of two departments were to be compared, *Y* department doing half as much business as *X* department. If the ordinary sales charts were superimposed, there would be two irregular lines separated one from another by a considerable interval. Even if the sales line of the *Y* department were moved upward until its beginning coincided with the beginning of the sales line of the *X* department, the lines themselves would not agree.

It is possible, of course, to renumber the dollar scale on the left of Fig. 12, that is, by letting one space represent $2,000 for *Y* department, whereas the same space would represent $1,000 for *X* department. But in that case, the same length would represent one number for one of the sales lines, and a different number for the other sales line. If the sales of three or more departments were to be compared, or the ratio

of the sales of the two departments were not so simple as 2 to 1, the complexity would become greater. The same disadvantages would occur if several distinct data relating to one department were to be compared with each other.

These difficulties are removed if a standard period is selected and the figure for it is represented by 100. Then for the same period the corresponding figure of any other set of data is likewise represented by 100. The number of dollars is entirely eliminated, and the data may be compared directly.

Suppose, for example, that it is desired to compare the unfilled tonnage of the United States Steel Corporation with the monthly sales of a given company. In the following table, figures are given in dollars and reduced to index numbers by setting the January figure in each case equal to 100 per cent.

Month	Sales of *X* Company	Index number	Unfilled tonnage, U. S. Steel corporation	Index number
January	41,000	100	9,478,000	100
February	70,000	195	9,288,000	96
March	97,000	236	9,056,000	93
April	105,000	256	8,742,000	9C
May	97,000	236	8,338,000	88
June	105,000	256	8,919,000	92
July	64,000	156	8,884,000	92
August	51,000	125	8,759,000	90
September	62,000	151	8,298,000	88
October	21,000	51	8,353,000	88
November	55,000	134	8,125,000	87
December	35,000	85	7,379,000	78

The index lines of the sales of *X* Company and of the unfilled tonnage of the United States Steel Corporation are charted in Fig. 15. It is not surprising to find

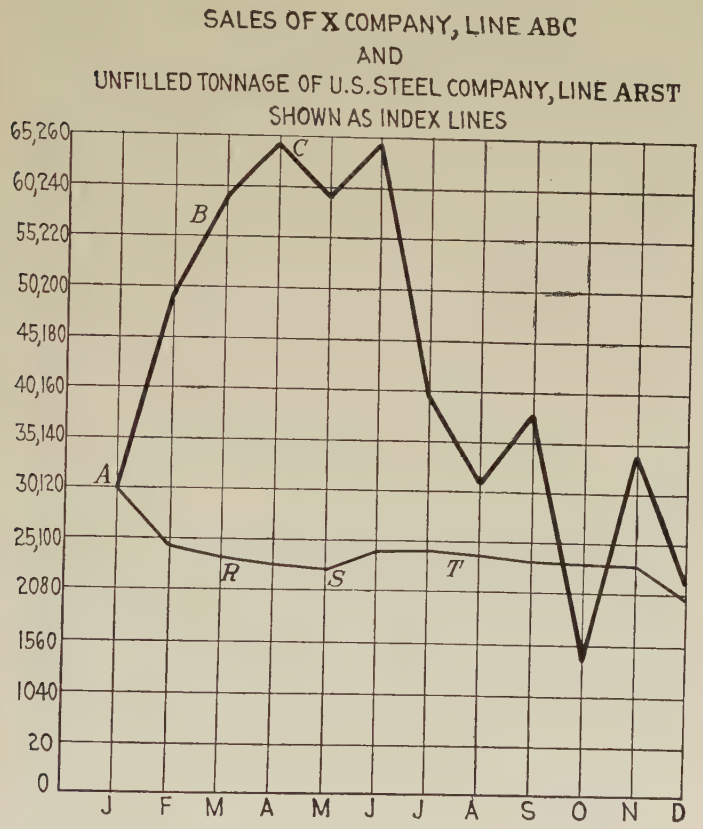


Fig. 15.

that the two index lines are not related. From a mere inspection of Fig. 12, it is evident that the business of *X* Company is seasonal; that most of its business is

transacted during the 6 months from Feb. 1 to July 31. The business of the Steel Corporation, on the other hand, is not confined to any specified part of the year.

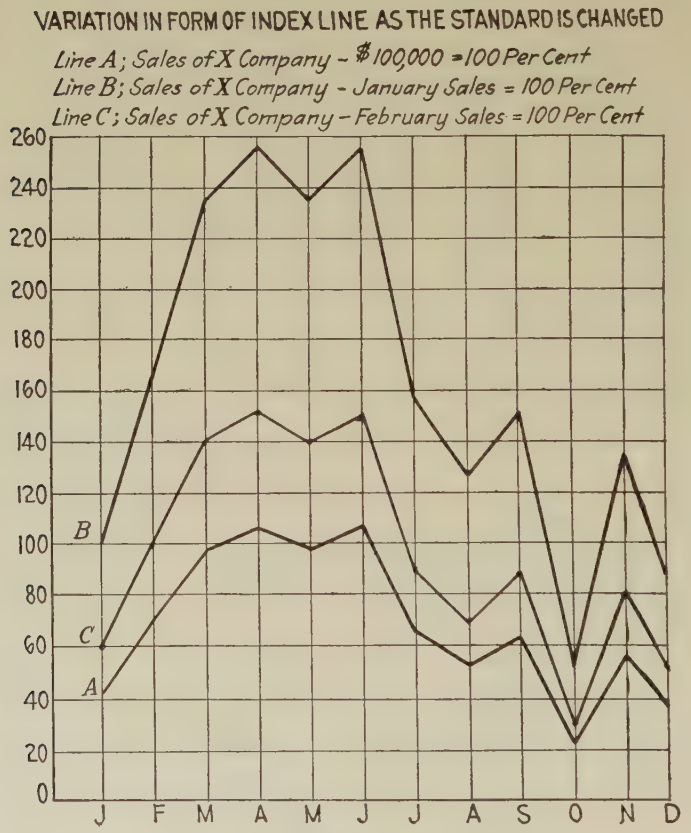


Fig. 16.

Hints for Charting Index Numbers.—It is important, when comparing two index lines, to make certain that the same period is taken as a standard for both

sets of data. In addition, the scale units must be the same for both lines. Suppose, for example, that in Fig. 12 the standard 100 represented $100,000. Then, the sales-index line would have the form of line *A* in Fig. 16. If, however, the sales for January were chosen as the standard, then the index line would have had the form of line *B* in Fig. 16; and if the sales for

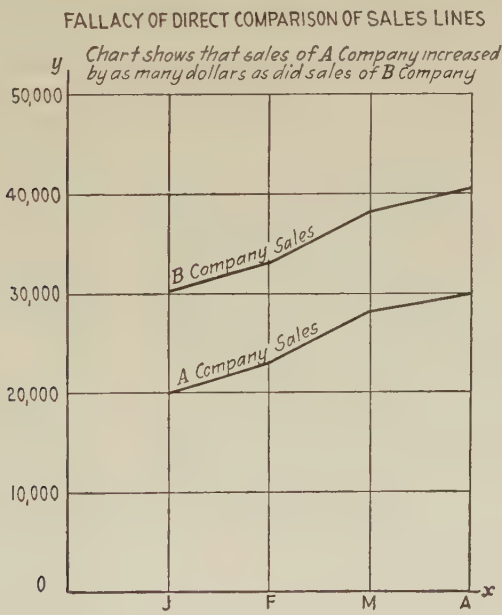


FIG. 17.

February were the standard, the result would be as in line *C*, Fig. 16.

The three lines, *A*, *B*, and *C*, have the same general form, but if *A* were moved upward, it could never be made to agree with either of the other two, even

though all three lines were drawn from the same data.

Suppose now that the sales of two departments, *A* and *B*, were as indicated in the table below, and charted as in Fig. 17.

Month	*A* sales	*B* sales
January	20,000	30,000
February	23,000	33,000
March	28,000	38,000
April	30,000	40,000

If *A* line were moved upward, it would fit exactly upon line *B*, because the *differences* are everywhere the same. The indication would apparently be that the results of the two departments were equally satisfactory. Such a conclusion, however, would be erroneous. The sales of the *A* department for February increased 15 per cent over those of January, whereas the sales of *B* department increased only 10 per cent. If the interest of the management lay in the rates of increase or decrease in sales from month to month, then the representation of Fig. 17 would be worthless, because it merely shows the absolute differences in dollars.

Suppose, however, that these sales figures are reduced to index numbers, the January sales being represented by 100. The index numbers would be:

	January	February	March	April
A	100	115	140	150
B	100	110	126⅔	133⅓

These are charted in Fig. 18, which shows that *A*'s sales increased more rapidly than *B*'s. But the chart is faulty because the percentage scale is not directly related to the number of dollars, 100 per cent meaning one number for *A*, $20,000, and another number, $30,000 for *B*.

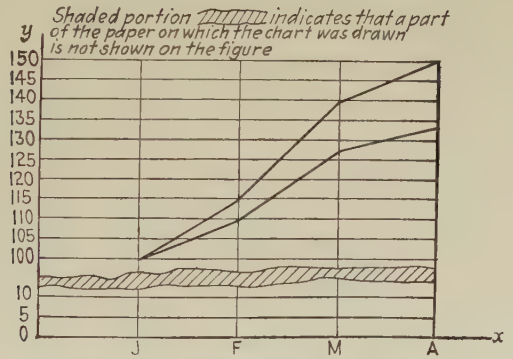


FIG. 18.—Sales of A and B companies (same data as used in Fig. 17) charted from index numbers.

The chart is also faulty because, although it is possible to tell by how many per cent the sales of April increased over those of January, it is impossible to tell by how many per cent the sales of April increased over those of March or over those of February.

Logarithmic Charts.—The rate of increase of any one month over any other month can be shown by using the logarithmic chart, where the paper is ruled differently. In the upper scale of Fig. 19 *A*, an increase of 10 is represented by a space of 1 inch, and every inch added means an additionl 10. The horizontal and vertical scale of Fig. 18 were made on the basis of such equal differences.

In the lower scale, an increase of space by 1 inch means that the previous number has been increased 100 per cent; that is, if the beginning of the scale is marked 10, the addition of 1 inch makes it 20, and the addition of a third inch makes it 40, which is an increase of 100 per cent over 20. An inch added beyond 40 makes a point which is marked 80, or an increase of 100 per cent over 40, etc.

On the vertical scale of the ruled paper shown in Fig. 20, numbers do not increase by equal *amounts* for equal spaces, but increase by equal *rates*. The construction of the vertical scale of Fig. 19 *C* is like that of the lower scale of Fig. 19 *A*. This is shown again in Fig. 19 *B*, where a rise of 1 unit means a multiplication by 10. Similarly, coming down the scale, the numbers do not decrease by like amounts for equal spaces, but decrease by equal rates. A unit distance down from *D*, marked 100, brings to *C*, marked 10. That is, 100 is decreased to $\frac{1}{10}$ of itself. If it is desired to decrease 10 to $\frac{1}{10}$ of itself, that is, to 1, it is necessary to come down from *C* the same distance as from 100 to 10, that is, to *B*. Going down the same distance will make the number $\frac{1}{10}$, then $\frac{1}{100}$, $\frac{1}{1000}$, etc., but never zero.

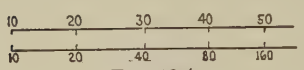


FIG. 19*A*.

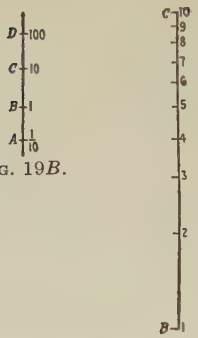


FIG. 19*B*.

FIG. 19*C*.

There is, therefore, no zero on the logarithmic scale. It is possible to start anywhere. *B* might have been

called $\frac{1}{10}$, in which case C would have been 1, and D would have been 10. On the other hand, A might have been designated 10; then B would have been 100, and C would have been 1,000; or if A is 100, B is 1,000, and C is 10,000, etc.

Construction of Log Charts.—It is necessary to understand the principle of the log chart in order to use it correctly. The intermediate points from B to C, in Fig. 19 B, and between any other pair of points are located with the same relations in view, and the scale looks as in Fig. 19 C. The dots are located so that the distances 1 to 2, 2 to 4, 4 to 8 are equal, each representing an increase of 100 per cent; the distances 2 to 3, 4 to 6, 6 to 9 are also equal, each representing an increase of 50 per cent; the distances 3 to 4, 6 to 8, are equal, each representing an increase of $33\frac{1}{3}$ per cent; the distances 3 to 5, 6 to 10 are equal, each representing an increase of $66\frac{2}{3}$ per cent, etc.; the scale being very carefully marked to be perfectly consistent.

But to make the scale consistent, a 50 per cent increase cannot be represented by half as long a distance as a 100 per cent increase; that is, the position of 3 on the scale cannot be midway between 2 and 4 because the space from 3 to 4 would then be equal to the space from 2 to 3 and would logically have to represent a 50 per cent increase over 3, whereas an increase of $33\frac{1}{3}$ per cent is required to make 3 become 4.

The meaning of "logarithm" is simple enough. If the notation 10^2 is used to represent 10×10, or 100; 10^3 to represent $10 \times 10 \times 10$, or 1,000, etc., the corresponding scales are apparent:

10^0	10^1	10^2	10^3	10^4
1	10	100	1,000	10,000

Going towards the right on the lower scale of numbers, each number is multiplied by 10 to obtain the next number; at the same time, the index of the 10 on the upper scale is increased by 1. Going from any number towards the left, it is necessary to divide by 10 on the lower scale and to decrease the index of the 10 on the upper scale by 1.

In any such relation as 10^3 equals 1,000, the figure 3 is called the logarithm of 1,000, so that from the above related scales the logarithm of 100 is 2, the logarithm of 10 is 1, and the logarithm of 1 is 0. Evidently the logarithms of numbers between 10 and 100 must be between 1 and 2. The logarithms of numbers between 1 and 10 must be between 0 and 1, and mathematicians have calculated them correctly to very many decimal places.

The scale divisions of the logarithmic-ruled papers are most easily found by logarithms, such as the following logarithms of the numbers from 1 to 10.

Number	Logarithm
1	0.000
2	0.301
3	0.477
4	0.602
5	0.699
6	0.778
7	0.845
8	0.903
9	0.954
10	1.000

In Fig. 19 *C*, the scale from 1 to 10 that is, from *B* to *C*, is 5 inches long. Then the scale mark 2 is placed 5×0.301, or 1.5 inches above the scale mark 1; the scale mark 5 is placed 5×0.669 or 3.5 inches above 1, etc. Since 10, 20, 30, 40, etc., to 100 are related to each other in precisely the same way as 1, 2, 3, etc., it is unnecessary to calculate the positions of 10, 20, 30, etc. The scale from 1 to 10 is merely repeated above 10 and the divisions are marked 20, 30, 40, etc. If the space between 10 and 20 is to be subdivided so as to show 11, 12, 13, etc., this space

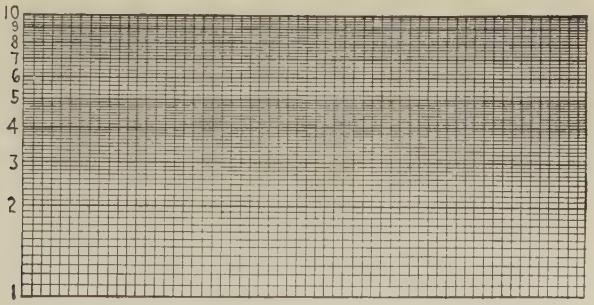


FIG. 20.—Logarithmic-ruled paper.

must be subdivided in the same way that the space between 1 and 10 was subdivided. (Scales on slide rules are made up in this manner.)

Paper such as shown in Fig. 20, on which the vertical scale is marked by means of logarithms as indicated above, but on which the horizontal scale is marked as in the previous charts, is referred to as semi-logarithmic paper, or ratio paper, and is technically known as arithlog paper. Charts drawn on such paper are termed ratio charts.

Use of Ratio Charts.—The best method of showing the use of the ratio chart is to use a practical example. The following data are charted in Fig. 21:

Month	*A* Company sales	*B* Company sales	*C* Company sales
January	1,000	5,000	10,000
February	1,500	6,000	9,000
March	2,250	7,200	10,000
April	3,375	8,640	12,000
May	5,062	10,368	18,000
June	7,593	13,442	20,000

This chart illustrates several notable features:

1. Where the monthly increases are at the same rate as in the case of *A* and also in the case of *B*, the chart shows a straight line.

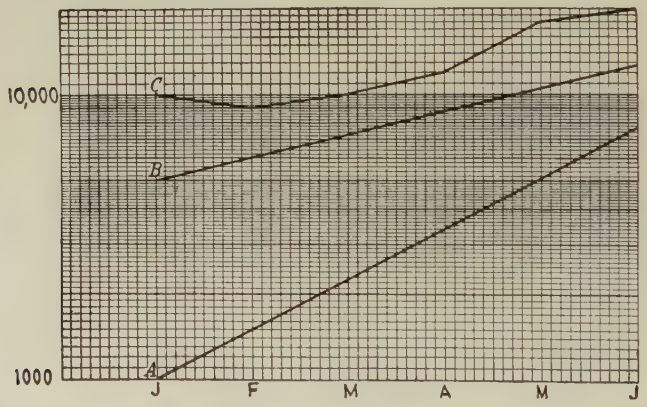


FIG. 21.—Sales of A, B, C companies charted on logarithmic paper.

2. The *C* sales line is irregular, but for the month of April it is parallel to the *B* sales line because the

sales of both companies increased at the same rate of 20 per cent; the C sales line is parallel to the A line for May because the sales of both the C and the A companies increased at the same rate of 50 per cent.

3. The steeper the line is, the greater is the percentage of increase. Thus, the fact that the A line is steeper than the B line denotes that the sales of A

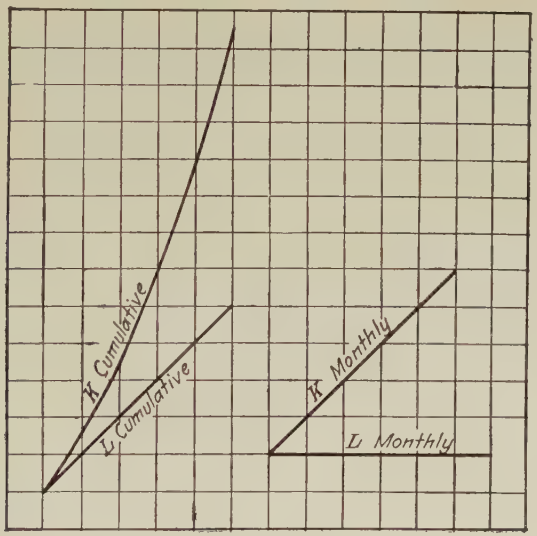


FIG. 22.

company increased at a greater rate than did the sales of the B company.

4. Since the space from 1 to 2 on the vertical scale represents an increase of 100 per cent, it is possible to compare the sales of the same company for any two months; thus from Jan. 31 to June 30, the C company increased its monthly sales 100 per cent. From April

30 to June 30, the *C* line rises a total of 8 divisions, counting downwards from 2. If the distance covered by these 8 divisions from 1 upward are laid off, somewhat less than 7 divisions are found to be marked off,

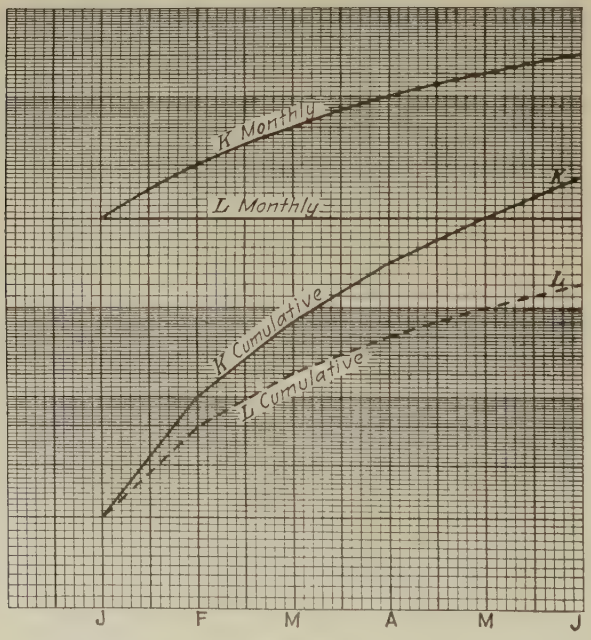


Fig. 23.

which means that for June the sales were somewhat less than 70 per cent above the sales for April. (Fig. 21.)

5. Decreases are always to be measured from 1 downward, so that the *C* company's sales for February being 1 division below the sales for January show a drop of 10 per cent. The sales for January are indicated as being below the sales for June by the space

2 to 1, and, if this space is measured downward from 1, the end of the fifth division is reached; that is, the sales for January were 50 per cent below the sales for June.

The first essential in attempting to read a chart is to determine whether the scales are difference or ratio, that is, whether the ruling is arithmetic or logarithmic. A chart which indicates the cumulative sales of a company is bound to have one characteristic property, namely, the line must rise. But the steepness with which it rises will be much greater on a difference chart than on a ratio chart.

Suppose, for example, that the sales of two companies, *K* and *L*, are as follows:

	K, monthly	*L*, monthly	*K*, cumulative	*L*, cumulative
January	20,000	20,000	20,000	20,000
February	30,000	20,000	50,000	40,000
March	40,000	20,000	90,000	60,000
April	50,000	20,000	140,000	80,000
May	60,000	20,000	200,000	100,000
June	70,000	20,000	270,000	120,000

Figure 22 shows how these figures for monthly and for cumulative sales would appear if plotted on ordinary difference paper. Figure 23 shows the same data as plotted on ratio paper.

CHAPTER VIII

PRESENTATION OF DATA

The great difference between scientific management and the management of businesses according to the lack of system employed by our fathers is primarily a matter of records. Modern procedure is marked by written reports instead of oral reports; written instructions instead of oral instructions; and written procedure instead of mere tradition.

This doctrine of reducing everything to writing is especially important when applied to making plans, particularly when other people have to be convinced of the practicability of these plans. The written plan, where statistics, graphs, and interpretation lead to logical conclusions, is far superior to that contained in one individual's mind. Charts, of course, are essential in the presentation of prediction and plans, because the ordinary mind has not the ability to picture trends unless they have been graphically presented.

The bases on which plans and predictions are made up are, as has been shown, both of a statistical and of a personal nature. The statistician can himself plot his graphs and show his logical trends, but he can rarely give forth the ultimate prediction or plan, because he has not the experience or requisite executive ability. He finds it difficult to discriminate between the theoretical values and those practical ones for which he can

find no mathematical measurement. In other words, the statistical interpretation by itself lacks the dollars-and-cents viewpoint.

It is, therefore, of the greatest importance to have the statistical reports presented by someone who, in addition to a grasp of statistics, is also thoroughly grounded in the conduct of the business. The ultimate purpose is to translate theoretical statistics into practical plans which can be put to profitable application.

The Written Report.—The value of a written report is unquestioned. It not only presents all the facts to everyone, but it gives an accurate analysis of the whole situation which allows the formation of definite plans on a scientific basis. Finally, if there is any uncertainty, it operates to clarify the situation, and serves as a record to prevent misunderstandings.

All predictions and plans in the past have been, for the most part, oral. No attempt has been made to work out on paper the method by which plans are arrived at. There has been generally a discussion with associates after which a policy has been decided upon, but without any conscious setting forth of this in writing. Nor is there usually any realization of the fact that whatever is done in one department is bound to affect the activities of every other department, and that such interrelations should be foreseen and planned for.

It is not too much to say that every company would profit by a written statement of its plans for the future, which would be both in the nature of a prediction and a guide to action. It would be an accu-

rate interpretation of factors bearing on the company's future with a probable forecast of the conditions to be met. Such a general report would, of course, be couched in general terms, but it would, nevertheless, be definite in application and absolutely neutral.

There are several examples of successful prediction reports, such as the financial forecasts of business conditions already described in a previous chapter. There are also the annual reports of large corporations which often contain a forecast of future plans of the company, although often without that careful statistical analysis which should by good rights accompany such a prediction.

Types of Reports.—Prediction and plans are of two distinct types:

1. The regular report, on a carefully ascertained subject, is presented at regular intervals, and brought up to date periodically. In this category come records and forecasts of purchases, production, and sales, and any other report of this nature. Such reports, of course, are largely statistical, and the interpretation is chiefly concerned with the statistical and graphic analyses contained therein.

The gathering, tabulation, and presentation of such data may profitably be left to the statistical department. It is not always easy, however, to determine which of these regular reports are of the most value, and whether some of them are not superfluous, and whether there are not other statistics which should serve as the basis of reports. M. B. Folsom, writing in the *Harvard Business Review* in respect to the Eastman Kodak Company, suggests that a study of the

entire business should be made, the important phases listed, together with the principal problems, and the chief functions of the various divisions. A comparison of these with the data already received by executives will tell whether they are receiving the information they are entitled to, whether they are getting too little, too much, or the wrong kind.

2. The second type of report is that which comes as the result of a conscious attempt to solve a problem according to scientific methods. It comes as the fruit of analytic research into the factors affecting the problem. While the regular reports guide the company in its forward progress and show whither it is tending, these special reports will indicate how conditions may be bettered by revising or changing present plans.

The Regular Reports.—Each company should have a definite and scheduled series of reports which will cover all phases of the company's activities and serve as a basis for prediction and planning. These may, of course, be classified according to the time of appearance, the person or persons who are to see them, or according to the departments of the business which are affected.

Figure 24 shows how the statistical work of the Eastman Kodak Company is divided among the various departments of the business.

1. Purchasing. Reports are made of general commodity movements by index numbers. Careful statistics are also kept of the commodities used by the company as raw materials. Internal records are assembled of purchases, receipts, consumption, and inventories. Forecasts are made from these.

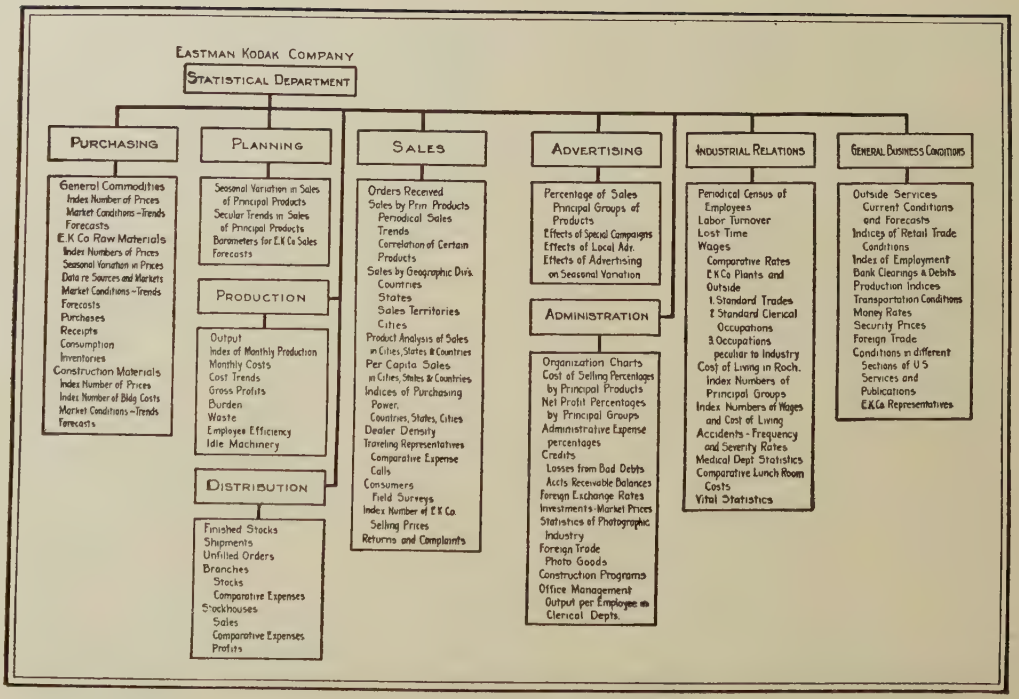


FIG. 24.—(*Harvard Business Review.*)

2. Planning. In this particular company, planning includes a report on seasonal variation in sales of principal products, secular trends in sales, barometers used for sales, and resultant forecasts.

3. Production. Output, monthly costs, profits, waste, employee efficiency, idle machinery, and other pertinent production statistics are subjects of reports.

4. Distribution. Under this heading come finished stocks, shipments, unfilled orders, branch stocks and expenses, and stock houses.

5. Sales. Sales records include orders received, sales by products arranged according to periods and trends, sales by geographic divisions, per capita sales arranged geographically, indices of purchasing power, dealer density, selling prices, and other statistics of this nature.

6. Advertising. Records are kept of the effects of advertising on seasonal variation and the results of regular and special campaigns.

7. Administration. Organization charts, cost of selling, net profits, administrative expense, credits, foreign trade, office management, and other statistics are included here under administration. This would differ, of course, with the individual company.

8. Industrial relations. This includes a periodical census of employees, labor turnover, lost time, wages, cost of living, index number of cost of living and wages, accidents, and vital statistics.

9. General business conditions. Under this heading are grouped the outside forecasting services, indices of retail trade and of employment, bank clearings and

debits, production indices, transportation conditions, money rates, security prices, foreign trade, and market conditions in different sections of the United States.

Securing Attention to Reports.—Much of the value of any report depends on the presentation. Unless the executives spend time to study these reports, all the effort which has been spent in getting them up is practically wasted. It is, of course, necessary to educate the whole organization as to the utility and value of such reports, but a great deal will depend upon the form of the report itself.

The report should be as simple as possible. While it may be valuable to include all the various data and researches which have brought forth certain conclusions, it should be remembered that the conclusions are the important part and should appear first.

Another fault which often occurs is that reports are too technical. This is a readily understandable mistake. The statistician who prepares the charts and writes the report forgets that the executive is not so expert as himself in interpretation.

In some cases, an organization has been oversold on the idea of statistical reports; a great many are issued which are purely of academic interest and of little or no practical value.

A report may require personal explanation, in which case the statistician or other person responsible should be allowed to trace the steps which have brought him to the conclusions presented.

The importance of illustrating reports is twofold. In addition to the added simplicity of comprehension, there is a pictorial element which goes a long way

towards securing the interest of those receiving the report. Individuals will study a graph where they will not read tables of statistics, and they will also study an illustrated report where they will avoid the one without the pictorial element.

Defining the Problem.—In addition to the regular reports which are made at periodic intervals, many of which will consist of nothing more than a chart, there are more elaborate reports concerning particular

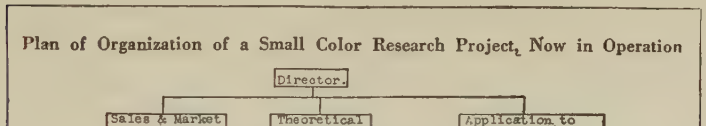


FIG. 25.—(*Textile World.*)

problems. These will have as their purpose the solution of some special difficulty, the analysis of some market, the advisability of undertaking a new development, or other phase of the business which is vitally concerned with the future.

The first requirement is to block out the problem so that there will be no confusion or waste of effort on side issues. This can be done in many cases according to the organization-chart idea (see Fig. 25). Here there are three main divisions: sales and market

investigation; theoretical research, which may include laboratory research; and application to works productions, or the combination of the theoretical and the practical.

Practically every problem can be dissected in this way into groups and subgroups, each of which must be solved separately before there can be any attempt at a synthetic solution.

Sample Prediction Problem.—The following outline of an actual prediction problem will give an idea of the complexity of the factors involved. The great importance of correlation should be noted. Every factor affects every other factor. Every business phenomenon is like a kaleidoscope. The movement of any single bit of glass causes the movement of every other bit.

Problem.—Will the *ABC* Company be able to get out of receivership? There are six major factors in this problem.

1. Ability to make sales.
2. Ability to obtain materials.
3. Ability to prevent creditors from demanding liquidation of assets.
4. Attitude of court.
5. Possibility of bringing out new products.
6. Factors which cannot be foreseen.

Each of these factors is, in itself, a problem, which is made up of other subfactors:

1. The ability to make sales depends upon:

   a. The market. The market for automobile parts is rapidly improving. Plus

b. Competition. Competition is keen, but competitors, with the exception of the *XYZ* Company, cannot sell at such low prices. Plus

c. Sales ability. The company is weak in this point. If the business is to be obtained, a new sales manager should be employed. (A controllable issue.)

d. Ability to make delivery. Customers demand better service, particularly since the company has gone into receivership. This can be taken care of. Plus

e. Quality of goods. No amount of salesmanship will help unless customers can be convinced that standards have been improved. This means changes in production department.

2. The ability to obtain material depends upon:

a. Cash available. This in turn depends upon:

(1) Making sales and getting prompt payment. Plus

(2) Getting accommodation at banks. This depends upon keeping their confidence, which can probably be done if the present management remains unchanged. Plus

b. Credit available. Little can be expected from this source. Minus

3. Ability to prevent creditors and stockholders from demanding liquidation of assets depends upon their confidence in the management. If the present receivership remains intact, and if sales continue at their present level, little trouble need be expected from this source.

4. The attitude of the court will depend upon:

a. The attitude of the banks, stockholders, and merchandise creditors (see 3).

b. The report of the receivers. This should favor the company. Plus

5. The possibility of bringing out a new and successful product depends upon:

a. Whether control can be obtained of the Jenks patents. This seems very doubtful. Minus

b. Whether, as an alternative, a device of the company's own invention can be developed to take the place of the patents already in existence. This will probably not be possible, since the court can hardly be expected to authorize a sufficient appropriation for experimental work. Minus

6. Factors which cannot be foreseen. Such possibilities as the death of one of the executives, fires, strikes, etc. do not seem within the range of likelihood, and are guarded against as well as possible; but of course a complication of unfavorable events might work against the company to the point of precipitating bankruptcy proceedings.

Following is a forecast based on the above condition:

1. Sales. Sales should be successful, providing a new sales manager can be obtained, and production arrangements altered so as to provide for an improvement in the quality of the goods. This is merely a question of careful management.

2. Materials. Assuming that sales are properly taken care of, there should be funds enough to buy materials, providing the banks will provide some accommodation. This they can be counted on to do as long as the present receivers stay in.

3. Creditors. If sales do not fall off, the creditors will prefer to take their chances rather than face liquidation. It is mainly a matter of keeping their confidence.

4. The court. If the creditors can be taken care of, there is little to fear from the court.

5. New product. Although the successful introduction of a new product would be the quickest solution of the problem, such a possibility is remote.

6. Conclusions. Although it seems hardly possible to introduce successfully a new line, it appears that by careful management the situation can be saved and that, barring the interception of unforeseen factors, the company can be brought out of receivership without some such expedient. The process, however, will probably be a slow one. It is doubtful, moreover, if the concern can be saved if the present receivers are not retained.

CHAPTER IX

CORRELATIONS

Various sets of statistics may be correlated, provided some relationship can be established between them. They are directly related if increases in one are associated with increases in the other, and inversely related if increases in one are associated with decreases in the other. Thus, the amount of work done is directly related to the number of men employed, if it appears that an increase in the number of men on the payroll is associated with an increase in the amount of work accomplished. The amount of work done is inversely related to the number of hours which constitute a day's work, if it appears that a decrease in the number of hours in the working day is associated with an increase in production.

It is not always easy to tell how data are related even when it is known that a relation exists. Thus, an increase in the number of people who attend theatrical performances may be related to general business conditions, either directly or inversely, depending upon whether the increase in attendance is in the evening or at matinees, but it is difficult to prove.

Whenever two series of data are related, either directly or inversely, so that a variation in one of the series is accompanied by a variation in the other, they are said to be correlated. It may develop that like

variations occur in the two series purely by accident, but the judgment of the investigator can usually distinguish between a true and an apparent correlation. A graphic representation of the two sets of data furnishes the simplest method of determining the extent and the character of the correlation.

It may happen that two sets of data are related in such a way that, although the variations in the two series are of the same kind, they do not occur at the same time, but variations in one series precede the corresponding variations in the other series. The discovery of two series related in such a manner is of the utmost importance, since it permits variations in one series to be used as predictors of variations in the other series. A careful distinction, however, must be made as to which series is to be considered cause and which effect.

Principles of Correlation.—The principles of correlation of causes to make forecasts have been summed up as follows by Ray Vance, of the Brookmire Forecasting Service:

1. When any one given cause of a given economic happening (such as change in price or a change in volume of production) varies, there is the same tendency (larger or smaller as the case may be) for the effect (price level, volume of production, etc.) to show a similar variation, and it is self-evident that variation in the effect must appear at a later point of time than variation in the cause.

2. If two economic happenings are results of the same general group of causes, then there will be a tendency for a given fluctuation in one of the results to be accompanied by a similar though not identical variation in the other result. It will frequently happen that throughout a series of variations one result from the same

general group of causes will consistently appear at an earlier point of time than another result from this general group of causes; an example of this being the fluctuation of industrial stock prices in advance of changes in general industrial conditions. In all such cases, in default of being able to measure all statistical causes of either movement, we may use the correlation between the two results as a method of forecasting the variations in the result.

3. If we are able to measure statistically more than one of the economic factors which are correlated with the movement we seek to forecast, then, by combining these factors in a properly weighted composite or average, we can more nearly approach a complete measurement of the variations in the entire composite of causes for the effect under consideration, and shall find our correlation improved, or, stated in simpler words, we shall be able to forecast more accurately.

There are many possibilities of making errors in correlating sets of statistical data. Some of these are difficult to recognize, although the main difficulties are included in the following:

1. Failure to distinguish all causes which concur towards a given result often brings about error. There are very few events which are the result of a single cause, and failure to give proper weight to all causes may entirely nullify a prediction. Even when the results appear substantially the same, the causes may differ in considerable degree.

2. No two exactly similar chains of events ever occur. Consequently, it is not possible to predict absolutely from events in the past which may on the surface appear identical. There are always some new factors to be taken into account.

3. Errors may occur through inability to measure exactly. If statistics are unavailable, if not enough

statistics are obtainable, or if there is any error in the statistics used, the forecast will be incorrect.

4. All components used in making predictions should be directly connected with the forecast.

Problems of Correlation.—There are a great many opportunities to correlate sets of statistics which have a bearing upon the company's activities, and which may serve as the basis of predictions or plans. The principal sets of correlations are, however, the following:

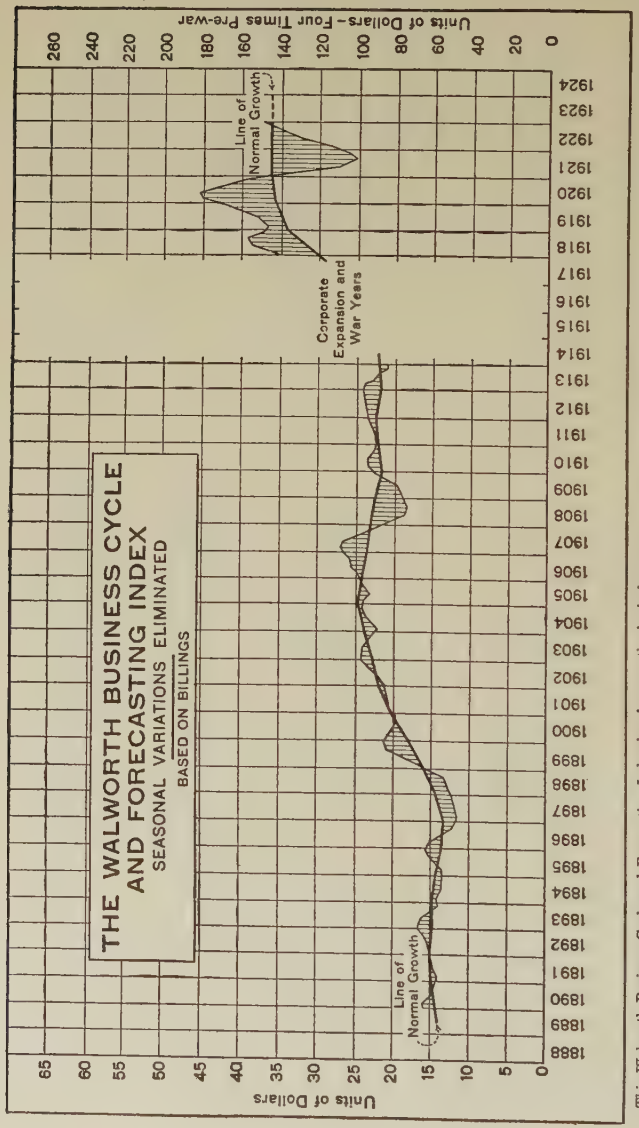
1. Correlation of the general trend of business, as supplied by one of the various forecasting services or prepared by the company's own statistical department, with the company's own figures.

2. Correlation of special barometers which have been shown to be closely connected with the company's activities.

3. Correlation of statistics of the industry with the company's own operating conditions. This will normally include a careful study of prices and price trends, and the recognition of the interrelation of prices in various industries, as described later in this chapter.

4. Correlation of internal statistics, showing the proper relation between purchasing, production, and sales.

Correlating the Business Cycle.—It is always desirable to know the relation which exists between general business conditions and the individual business. If some definite and calculable relation can be determined, this will be of immense benefit in making plans for the future. It is essential, of course, to discount fluctuations caused by conditions within the company



This Walworth Business Cycle and Forecasting Index has become the basis for:
1. Correlation, as is, with Babson General Business Barometer. 2. Calculation of + and — deviations for correlation with "B" Curve of Harvard Index of General Business Conditions. 3. Correlation, as is, with Dodge Building Contracts Awarded, Dollars, Corrected for Seasonal Variations. 4. Selection of most nearly comparable calendar years of the business cycle.

FIG. 26.—(*Administration.*)

or the industry, and to take into consideration only those factors which are of universal application.

Correlation with the business cycle, however, is not in itself sufficient. This merely indicates direction and in some cases length of time or duration of a trend. It does not give percentage or rate of increase or decrease, which is usually given by some so-called business barometer or index. The purpose of correlation with the business cycle is to show how normal growth will be affected by outside prosperity or depression.

Figure 26 shows how the Walworth Manufacturing Company uses its business cycle and forecasting index, after eliminating all seasonal variations. There is a 3 to 9 months' lag when correlated with the Babson Barometer Index. There is almost exact correspondence in direction and in point of time with the *B* curve of the Harvard forecast. Rate of increase or decrease is secured by charting the figures as to building contracts awarded.

Barometers and Correlation.—It is frequently found that there is some definite relationship between an important group of the company's statistics and some outside index. The Eastman Kodak Company, for example, has found a well-defined correlation between its sales and the Employment Index (number employed throughout the country), which varies in advance of the company's own sales figures. Although the exact amount of lag differs, a good measuring device is obtained by using an average lag.

The Walworth Manufacturing Company found that the statistics of the F. W. Dodge Company as to

building activities showed a direct relation with the business curve of the company. That is, whenever building advanced over the preceding year, the business of the company showed an equal percentage of increase, and the same was true with the decrease. In other words, the same causes which led building operations to increase in activity were also operative upon the Walworth Company's sales.

Each index is, on a small scale, a reflection of the composite of business conditions generally. But the curve of a special index rarely runs parallel to the general curve. In the case of stocks, it antedates it, while in the case of prices, it follows at some time afterwards. The peaks of the index used may not correspond with the peaks of general conditions, because the latter is an average, while the former merely represents one set of conditions.

To show how an index number can be used in prediction, suppose that the index of commodities is correlated with the index number of the unfilled tonnage of the United States Steel Corporation over the last major crisis of 1920–1921.

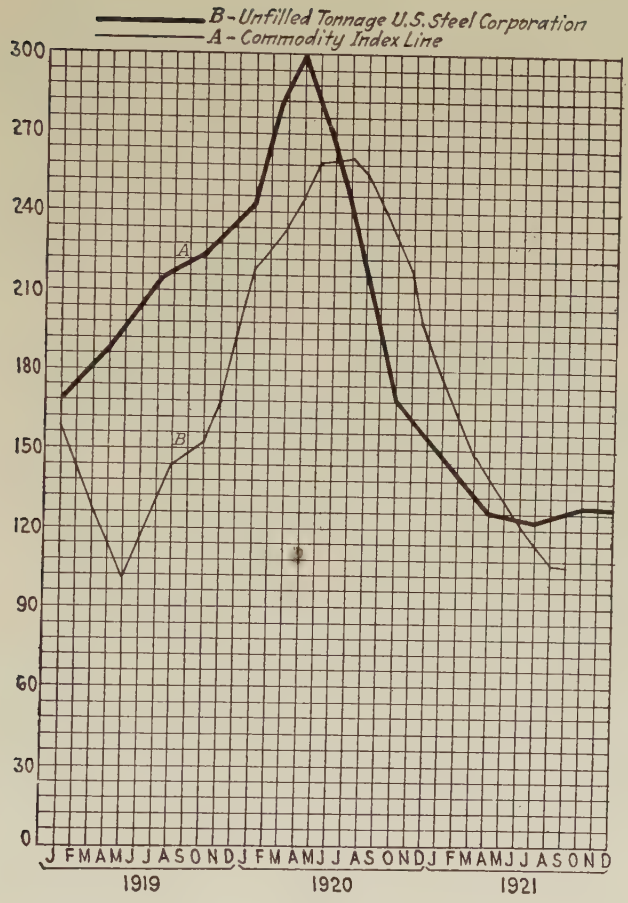

B - Unfilled Tonnage U.S. Steel Corporation
A - Commodity Index Line
300
270
240
210
180
150
120
90
60
30
0
A
B
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1919
1920
1921

FIG. 27.

The following figures are charted in Fig. 27.

	Commodity-index number *A*	Unfilled-tonnage index number *B*
1919:		
January	168	157
February	174	141
March	180	128
April	187	113
May	195	101
June	204	115
July	213	131
August	218	144
September	222	148
October	226	152
November	231	168
December	236	194
1920:		
January	242	218
February	263	224
March	284	233
April	304	243
May	284	258
June	264	259
July	245	262
August	220	254
September	194	244
October	169	231
November	162	212
December	155	192
1921:		
January	148	178
February	141	163
March	133	148
April	126	138
May	125	129
June	124	120
July	123	114
August	125	107
September	127	107
October	128	
November	128	
December	127	

Here line *A*, the commodity-index line, clearly foreshadows the movement in line *B*, the unfilled-tonnage index line. For example:

1. Though prices began to climb from the beginning of 1919, orders did not begin to increase until May, and then prediction could have been made at the beginning of 1919 that within a few months orders would begin to pile up.

2. Orders did increase at a rapid rate until May, 1920.

3. Commodity prices had reached the peak in April, 1920, and in May of that year the steel company, seeing commodity prices breaking, could foresee that within a few months its unfilled orders would begin to decline, even though at that time and, in fact, even in July, its unfilled orders were still piling up.

4. Unfilled orders reached the peak in July, 1920, and began to follow the lead of the drop in commodity prices.

5. In May, 1921, commodity prices began to show a tendency towards steadiness, and by June or July the steel company again had an opportunity to prepare for a resumption of business on a large scale.

Here is a case of a barometer which can be used to forecast future sales of a single company.

The Interrelation of Industry.—Business concerns, as producing units, are classifiable according to their positions with reference to the raw materials of the earth on the one extreme and to the consuming public on the other. Nearest the material resources are the *primary industries* which fall into two subclasses, namely, the extractive and the genetic. In the extractive group are quarries, mines, lumbering concerns, hunting, fishing, cattle grazing, and similar industries which simply appropriate materials that nature has

ready at hand for the taking. The genetic industries work with the biological forces of nature so as to foster crops that may be reaped successively. Here are to be found all agriculture, horticulture, and animal husbandry. Some of the products of the primary industries, such as fruits, fish, nuts, and vegetables, are immediately ready for consumption, and fall under the heading of consumption goods.

Most of them, however, such as wheat, cotton, wool, hides, ores, and minerals, pass on to the next group of industries, namely, the *manufacturing industries*, to be further worked up and combined into goods that can be used either for consumption or to serve in further production. The manufacturing processes are sometimes many and complex. In this case, much time and many operations are required between the extraction of the raw material from nature and the ultimate use of the article by man in further production or final consumption.

The third great group of industrial activities are those connected with *merchandising*. Here are to be found the wholesale dealer, the jobber, the retailer, and other less well-known types of middlemen. They serve the public by getting things into convenient places at convenient times for service.

The *service* group interacts between the primary, the manufacturing, and the merchandising groups. There are several varieties of service. For example, the transporting and storing system has to do with the physical transportation and handling of goods between all the individual business establishments and also the various consumers. Another service group is that

which has to do with credit, money, and banking. To these can be added the personal-service group of doctors, teachers, actors, personal attendants, and the like.

The interrelation of industrial groups is pictured graphically in Fig. 28.

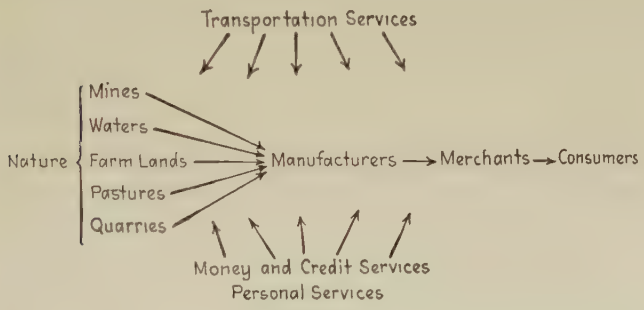


FIG. 28.

Production versus Consumption.—Production flows from natural sources of raw materials to consumption. Prediction concerns itself with the volume and the rate of flow. How much wheat, for example, will be thrown on the market next month, 6 months from now, a year from now, etc.? This factor will influence the farmers, the millers, the transporters, the banks, and the consumers of bread. There is equal importance attached to the output of copper, coal, or iron ore at the mines, and other commodities. The flow will depend upon the factors of production that are tapped at each way station, such as land, materials, power, labor, machinery and other capital goods, and the brains of enterprise.

Production is largely a matter of technique and management. It regulates supply. But the other aspect of economic life—the consumer or demand side—must be considered. The consuming public *values* or estimates the relative importance of units of various goods it wants. This demand acts as a pull and determines the direction of production. The public values only consumption goods and services. All other things have importance only as they are essential to the production of the valued articles of use. If the public ceases to demand beer, then breweries fall in importance. This affects the demand for barrels, glassware, and all the paraphernalia of wholesale and retail dispensation of beer. Labor engaged in the industry is temporarily out of work or released until it finds some other branch of service that assists in the forward flow of production in lines that are in demand.

That is, while rate and quantity of production in any line move up from natural sources to the consumer as a supply, value and demand flow back from the consumer towards the ultimate resources. If these two flows are properly adjusted to each other, and if they are moving with fair rapidity, then general business conditions are good. If they are accelerated, there is a period of prosperity, and a general rise of prices occurs. If they are retarded, there is a depression, and prices fall.

Interrelation of Prices.—The value of a commodity is determined by the price which the public is willing to pay. This price is extremely sensitive in the majority of cases to the state of demand. Any

attempt to support it artificially may delay but not prevent the ultimate adjustment.

The first effect of a change in general business conditions is reflected in the price of raw materials. These are in close adjustment to supply and demand because the intermediate steps between production and consumption are few. The more steps which intervene between production and consumption, the longer it takes for the price influence to be reflected.

The interrelation of price movements is summed up as follows by Leonard P. Ayres, vice-president of the Cleveland Trust Company, and an authority on the influence of the business cycle on business:

1. Wholesale prices move first and farthest.
2. Retail prices move more slowly and less violently.
3. Wage levels change more slowly than prices.
4. Manufactured articles, having a high labor content, change their price levels more slowly than do raw materials, having a low labor content.
5. Salaries change more slowly than wages.
6. Rents change more slowly than prices, wages, or salaries.

The middleman who has a large inventory on hand does not care to reduce his prices and clear out his stock at once, because he dislikes taking the inevitable loss. In many cases, of course, he takes a severer loss by holding up his prices until his competitors are underselling him. But the small dealer, for example, knows little about business conditions as applied to his own store. He cannot see that the best way for him to make a profit when prices are falling is to clear out the stock of merchandise which he had purchased at high prices and substitute a new stock bought at

bottom prices, on which he can make a good profit through quick turnover.

Correlation of Internal Statistics.—There are many sets of statistics having to do with the company which can be correlated to advantage. Purchases, production, and sales, for example, should be correlated with the seasonal trend.

Figure 29 shows how the Walworth Manufacturing Company divides its 23,000 products into seven group classes, and compares them with the average index and with the Walworth Business Index. When making up the chart, all violent fluctuations were eliminated, because they were found to be due to such factors as increase in manufacturing facilities, addition of a new branch, an added line or product, or some similar definite cause.

The normal development of the business was found to follow an almost parallel course with the rise and fall of general business, with the exceptions of the extremes, whereas the Walworth line neither rose so high in times of prosperity, nor fell so low in times of depression.

Group movements were found to differ from the average movement, but the movement of the same groups in years that were similar was almost identical. An analysis of sales records showed:

1. That in certain months of a given year there were different variations from the normal line in different units. This was accounted for by various local factors, such as weather, seasonal demand, transportation, and so on—all factors that could be foreseen and discounted in advance.

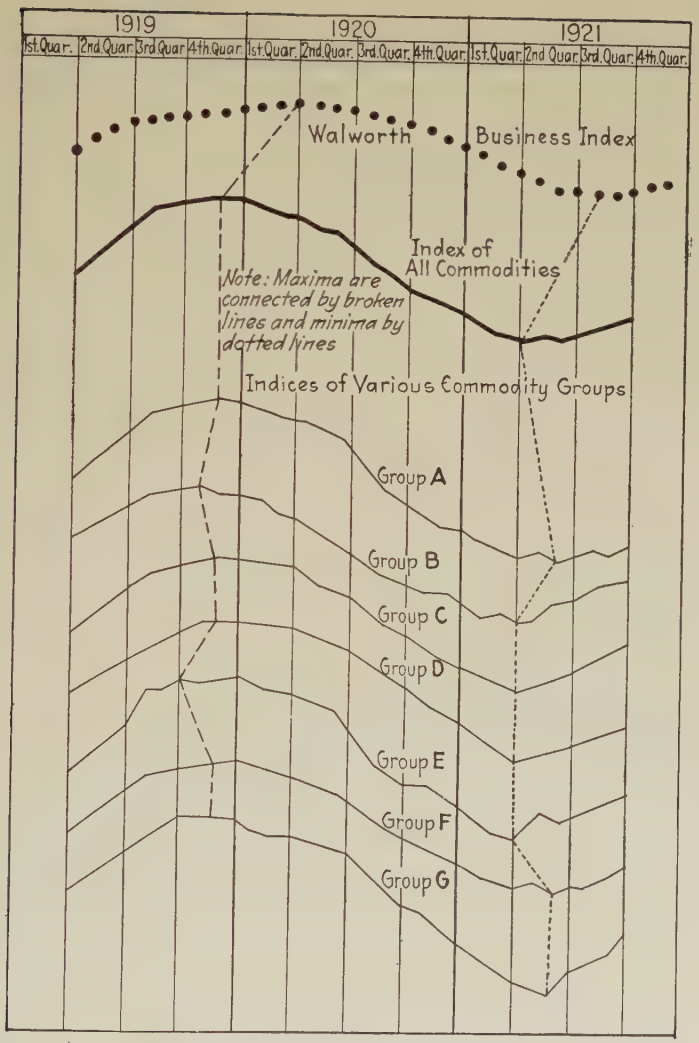


FIG. 29.—This chart reveals how the groups of Walworth commodities follow the general trend of Walworth business. (*Business Magazine.*)

2. That invariably the normal growth or decline of any or all sales units was the reflection of a comparable increase or decrease over a period of a year in business in general, as charted by the Harvard curve.

3. That in years that were similar, the curves of group movements in sales units were practically parallel.

CHAPTER X

TECHNIQUE OF PLANNING

Practical prediction, when applied to business, is almost synonymous with scientific planning. Such plans are of two types, according to the purpose for which they are used. They may, for example, be positive and constructive, or they may be negative and preventive. The former are in the nature of a decision to act; the latter carry with them the idea of avoiding action.

Careful distinction should be made between plans and policies. A policy lays out a general line of action, while the plan lays out a course of action for the future. All plans should make provision for changes brought about by changed circumstances. The best plans are those which permit flexibility. In some cases, it may be possible to lay out several sets of plans, and then to choose that plan which at the time seems to fit the situation best.

In each business, there will be major and minor plans. The major plans will be concerned with the operation of the business as a whole; while the minor plans will take care of the operation of the separate units of the business. All minor plans will have to be subordinated to the major plan.

The Constructive Plan.—The term "planning" as ordinarily used in commercial language is generally

understood to mean "constructive" planning. In this sense, it may be likened to military tactics. It is aggressive and active. It plots out new developments and tries out new methods.

The feature of the constructive plan is the quota or some other method of measuring accomplishment. Much of the success of the plan depends on how the goal of accomplishment is fixed. If it is placed higher than it is believed possible to achieve, it will serve mainly to point out the way, but it may cause discouragement because of inability to meet it. If, on the other hand, it is placed too low, there is danger of losing that aggressive spirit which is so valuable in making a business successful.

A compromise can sometimes be effected by having major plans for use by directors, with a high standard of accomplishment and serving as a guide for operation. Then minor plans for use by heads of departments can be based on a schedule of achievement for which they will hold themselves responsible. There will be a certain margin to take care of unforeseen eventualities.

Major plans can be made for some time ahead, because details can be largely eliminated. Minor plans, on the other hand, although they may be made for a year ahead, must be revised at frequent intervals in accordance with changed conditions.

It is the misfortune of the small business that it does not have any well-concerted major plan of action. It is conducted on a purely day-to-day basis, without that "looking forward" which is so essential to growth. The large business, however, often has an entire depart-

ment devoted to planning, and the details of planning, or scheduling.

The Negative Plan.—A negative plan carries with it the idea of avoiding action. It must not be supposed that a negative plan is valueless. On the contrary, some of the wisest plans ever made have been negative. Some business men have been highly successful on account of their ability to size up the duller and less promising aspects of business, and their generally conservative way of looking at things. The man who does no progressive planning at all, and who merely continues in the same old rut may stand a better chance for success than the brilliant administrator who is always introducing improvements, but who has no eyes for depressions, failure of plans, necessity of retrenchment, and other unpleasant prospects. The scientific forecaster faces a risk as squarely as he does an opportunity.

The negative plan aims to avoid and to eliminate risk. It aims to reduce chance to a minimum. It is always possible for the timid business man to unburden himself of practically any risk, but by doing so he is losing a large opportunity for profit. Furthermore, if the premium paid is unduly high, it may be better business to assume the risk himself. Risks which may be covered by insurance are "determined risks"; that is, the insurance companies have carefully worked out the prcentage of risk, and on that computation, charge premium rates which will cover it and return a reasonable profit. Those ordinary risks which are occurring every day and which it is not unreasonable to expect may happen at any time are those covered

most frequently by insurance. The multiplicity of their occurrence allows the formation of statistics ample and full enough to permit accurate predictions as to the long-range losses incurred by the insurance companies, whether fire, life, accident, or other type.

But there are other risks, no less disastrous in their final results, which are seldom covered by insurance. The rarity with which they occur, and the relative impossibility of obtaining accurate and complete data regarding the losses, make the cost of the premium in ordinary cases too high to warrant the price of protection.

One of the chief merits of the negative plan is the measurement and comprehension of the various risks, and the provision made for each one.

Alternative Plans.—Alternative planning is merely a recognition that something may occur which will render one plan inoperative, and make it desirable to have another plan ready to take its place. Especially when there are several contingencies which may eventuate, a plan should be prepared for each one. For example, a company may decide if the city appropriation for installing automatic gas-lighting devices goes through that it will proceed with the manufacture of the automatic gas-lighting device; but that if the appropriation is defeated, it will continue to manufacture buttonhole machine parts.

With the passage of time, the outcome of a plan inevitably becomes more apparent. One contingency after another disappears, and alternatives become fewer and fewer, while one issue gains constantly in strength until gradually it becomes a certainty.

Accordingly, it is necessary to revise plans at frequent intervals, and to keep them strictly up to date. Planning should always be regarded as a continuous and sustained process. Rigid adherence to a plan is like attempting to use a boiler without a safety valve, and like the boiler, when under excessive pressure, the rigid plan may cause great damage.

Revision of Plans.—There is undoubted danger in planning too far ahead. Plans should be flexible and plastic, and not rule-of-thumb affairs to be drawn out and fitted to the individual case, regardless of their suitability. There are few eventualities which may not at some time require radical changes in plans. As soon as a plan becomes out of date, it is dangerous and should be discarded, or, at least, revised.

The need for continuous revision of plans has given rise to the so-called planning board. The purpose of a planning board is to visualize by graphic methods future facts which otherwise would be too complicated to be comprehended readily. There are many types of planning boards, but they are all so arranged as to assist in coordinating plans and in making schedules work out in proper sequence.

If a plan requires frequent changes, an immense amount of rewriting and retabulation would be needed without the use of the planning board. One of the first uses of the planning board was in the preparation of railroad schedules. Figure 30 shows this original method of operation: The lines *AA*, *BB*, *CC*, *DD*, *EE* represent terminal stations of a line. Train No. 50 leaves station *A* at twelve o'clock, stops at *B* and *D*, and arrives at *E* at 1:40 p.m.; it then returns to *A*,

arriving there at 3:15 p.m. Train No. 60 leaves *A* at 1 p.m., stops at *C*, and arrives at *E* at 3 p.m., etc.

Pegs are placed at the various points on the lines representing the stations at the positions indicating the time of arrival or departure of trains, and different colored threads are run from *A* to *E* and back to *A* to represent the different trains. Thus train No. 50 would be indicated by a blue thread and No. 60 by a white thread.

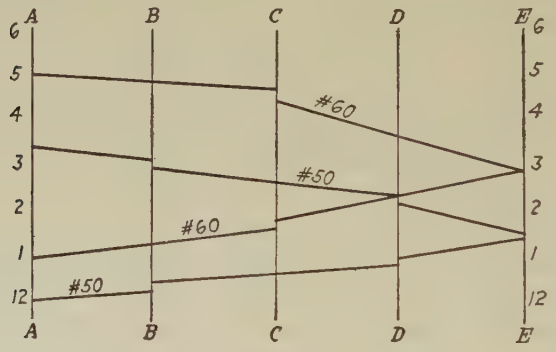


Fig. 30.

Evidently No. 60 and No. 50 will pass each other between stations *C* and *D* and nearer *D*. It may be desirable to revise the plans so that No. 60 may pass through *D* while No. 50 is stopping there. This can be done by merely shifting the pegs so as to provide for a shorter stop at *C* or for a longer stop at *D*. For a short line of 50 miles, the number of threads may be considerable, but after shifting them about until a satisfactory position is reached, a time table is carefully prepared. But the planning board shows the

despatcher at *A* the exact location of any train at any time, and gives him a more comprehensive grasp of the situation than any set of tables can possibly do.

Planning Board and Production.—One of the chief uses of the planning board is to schedule production. Suppose, for example, that a certain department of a company assembles automobiles from a large number of parts, either purchased or delivered from other departments. Each part requires a definite length of time for additional operations to be performed upon it. Suppose, further, that this department undertakes to turn out 1,000 cars in 6 months. It would evidently be poor policy to tie up money and use shop space for those parts which will not be required until towards the end of the process. Such parts must be ordered for immediate delivery, but they must be ordered so as to insure delivery at a time which will avoid the waste of idleness for workers and plant.

The problem of ordering becomes highly complicated, and the burden of responsibility may be a heavy one. The executive in charge of the plant may simplify his problem by using a planning board. Of the many forms possible, the following is one of the simplest: A board is marked into squares, with holes at the corners of the squares into which pegs may be inserted. The horizontal rows of holes will be labeled with dates of delivery, at intervals of a week, and the vertical columns will be labeled with the names of parts to be ordered. A set of cardboard or metal discs, having holes at the center and bearing numbers, such as from 50 to 1,000, completes the equipment.

Suppose the first lot of 100 cars requires 1,000 castings No. 1, 800 castings No. 2, 400 castings No. 3. If work is started Jan. 5, the machining of these castings will keep the shop busy for 2 weeks. Pegs, therefore, are placed at the Jan. 5 mark (see Fig. 31) and

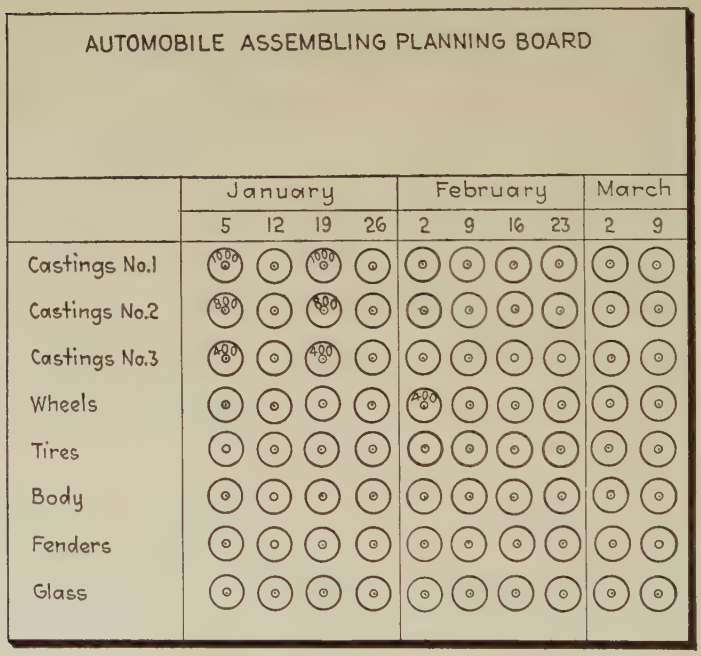


Fig. 31.

a disc slipped over each, bearing the required number as indicated in the figure.

The next lot of castings must be in the shop by Jan. 19. This is again indicated by setting pegs at Jan. 19, and slipping discs over these pegs.

Wheels will not be required until Feb. 2, when 400 are needed. The procedure for the remaining parts is a repetition of the routine already described.

An executive with a planning board such as the above will have an advantage over one not using such a device. If anything comes up to disturb the order originally planned, the board can be changed by simply altering the position of the pegs or of the discs.

Planning Board and Inventory.—The planning board can often be used to advantage in scheduling purchases and controlling inventory. Instead of

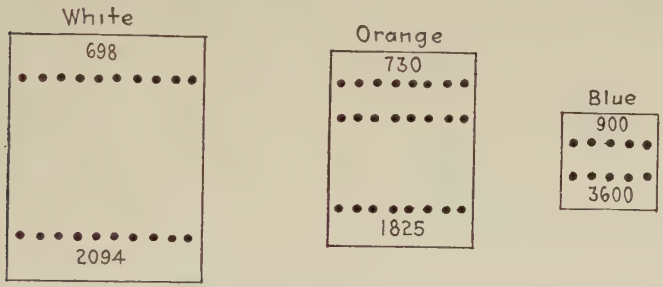


Fig. 32.

round pieces of cardboard, square ones of different colors and sizes are more convenient. Suppose, for example, that three articles are to be considered during the course of 3 months. Three cards, orange, white, and blue, are taken, as illustrated in Fig. 32.

The largest cards, in this case, the white ones, are used to note the number of units in the inventory of a particular article at the beginning of the month, and also the total money value at the last purchase price. Thus, there were 698 units of article *A* at the beginning of January when stock was taken, and the value

per unit was $3, making a total of $2,094. The dotted lines below 698 and above 2,094 also indicate the width of the next card, in this case, orange, which is used to indicate purchases of the same article. In the illustration, there were 730 units of article *A* purchased in January at a price of $2.50 per unit or at a total cost of $1,825.

When the white card has been set on the January peg, the orange card is placed on the same peg, and only those parts of the white card which bear the numbers are left uncovered by the orange card.

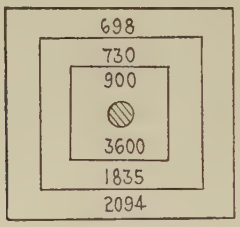


FIG. 33 *A*.

FIG. 33 *B*.

Similarly, the blue card is used to denote the number of units of article *A* sold in January. As 900 of these were sold at $4 per unit, the total 3,600 is entered on the bottom of the card. This blue card is then placed on the January peg and covers the orange card, leaving only the numbers exposed. The three cards will then appear as in Fig. 33 *A*.

The record for the month of February will begin with the following figures on the white inventory card:

Number of units 698 plus 730 minus 900 equals 528
Value at $2.50 per unit equals $1,320

The card will accordingly appear as in Fig. 33 *B*.

The inventory is now calculated from the record of purchases and sales and is not the result of actual count. A perpetual inventory is thus furnished for each article, and some particular item may be counted

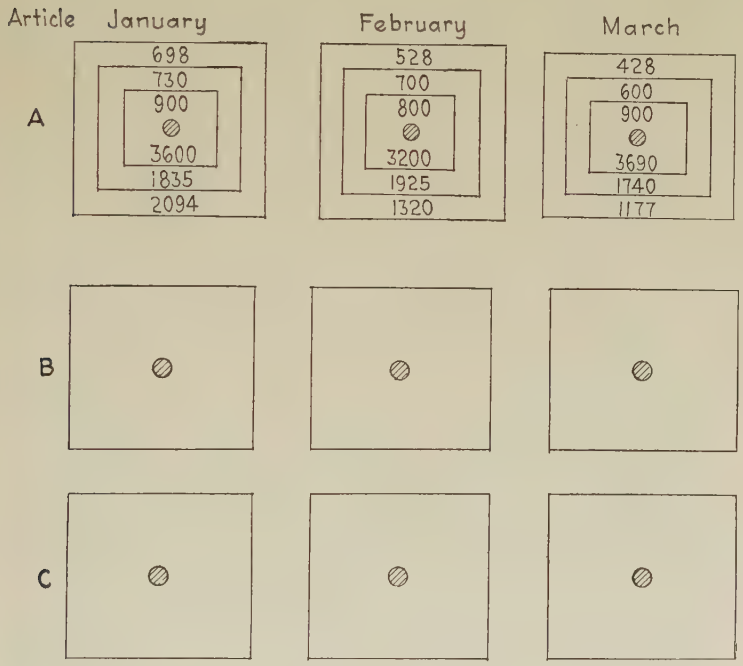


Fig. 34.

whenever desired to check up on the calculated inventory. Any large discrepancy can be discovered in this way, and the leak, if one exists, can be stopped.

The complete planning board for the 3 months on article *A* appears as in Fig. 34.

A summary for each article can be made quickly and easily as follows:

Purchases for 3 months	$ 5,500
Add initial inventory	2,094
Total	$ 7,594
Deduct final inventory	371.20
Cost of sales	$ 7,112.80
Sales	10,490.00
Gross profit on sales	$ 3,377.20

To illustrate, consider only three articles and their business history for 3 months, although the extension can readily be made to any number of articles for any period, whether of days, weeks, or months. It will be convenient to have, instead of round pieces of cardboard, square ones of three different colors and sizes, as follows: The largest cards, say the white ones, are to be used to note the number of units in the inventory of a particular article at the beginning of the month and also the total money value at the last purchase price. Thus there were 698 units of article *A* at the beginning of January when stock was taken, and the value per unit was $3, making a total value of $2,094. The dotted lines below 698 and above 2,094 also indicate the width of the next card, orange color, which is to be used to indicate purchases of the same article. In the illustration, there were 730 units of article *A* purchased in January at a price of $2.50 per unit or at a total cost of $1,825.

The turnover may also be easily calculated. If by "turnover" is meant the number of times that the normal quantity of goods on hand is sold during the year, it would be necessary to find the average quantity on hand each month. To find this, take half the sum of the inventories at the beginning and at the end of the month and obtain:

	Units
Average for January	613
Average for February	478
Average for March	278
Average for 3 months	456
Sales for January	900
Sales for February	800
Sales for March	900
Sales for 3 months	2,600

The average inventory 456 is contained in the total sales almost six times. At this rate the turnover for the year would be 24. This number is an index of the rapidity with which article *A* moves, the particular number 24 indicating that each unit of article *A* remains in stock for 2 weeks on the average.

The buyer would note the steady sale of the article and plan his purchases accordingly.

To calculate the profitableness of the article, he would note that the average value of the inventory is $1,243.20 and that the gross profit on sales is $3,377.20. If overhead expenses are 15 per cent of sales, the overhead expense for the 3 months was $1,573.50, leaving a net profit of $1,793.70 which at the same rate would

amount to $7,174.80 by the end of the year. Apparently, article *A* is very profitable to carry, and it may be worth while to incur advertising expense with the view of increasing the sales or of improving the quality of the article without advancing the price.

At the end of any period, the data on the cards may be used for graphic presentation.

Putting Plans into Effect.—The point at which many planning departments fail is the actual putting of the plan into practice. To do this effectively, according to E. A. Filene, the eminent authority on retailing, the following rules are helpful:

1. Make the plan in writing. A plan which is contained merely in someone's head cannot take concrete form. The effective plan must have a permanent basis.

2. Compare it with the methods of the most successful men. In this way, it may be possible to determine how other plans, similar or dissimilar, have worked out in practice.

3. Have it criticized in advance by those it will affect, and anyone else who can be helpful. Such advance criticism may guard against the criticism which is sure to follow the putting into practice of any new plan.

4. Put it into operation.

5. See that it keeps itself in operation until rescinded. As long as the plan does not operate automatically, it has not been organized effectively.

6. Keep the plan open to revision, but do not allow it to be changed except after the most careful consideration.

Consideration of Plans.—The executive should be careful before he acts upon any plan which he himself makes or which others make for him. In carrying out a plan, the following procedure is recommended:

1. Study the situation from every angle.
2. Tabulate the factors in question.
3. Make out a definite plan for the period to come.
4. Write down this plan, using unequivocal language.
5. At the time for which the plan was made, write down opposite the plan the actual conditions. In case figures are used, it is possible to set these down for purposes of actual comparison.
6. Note carefully what factors prevented the plan's coming out differently from the forecast.

By keeping careful track of the outcome of plans, the business man can determine whether he can afford to back up his forecasts and plans with all the resources at his command. Planning reports for executives may be made up in pocket size, showing results over certain periods. The use of graphs is desirable to indicate more exactly how the plan compares with the actuality.

CHAPTER XI

BUDGETS

The budget idea was originally applied to control the financial affairs of municipalities, states, and other legislative units. Its application to business has come about almost entirely since the World War. Although each separate business may build up its own budget system, the principle in each case is the same. The budget sets up a definite goal of attainment, and furnishes a yardstick by which all phases of the business program may be adjusted. That is, purchasing, production, sales, advertising, and administration are coordinated by means of the budget.

The budget originated to control costs and prevent waste. This is still one of its principal functions. It controls costs not only for the business as a whole, but for each department, because the company's budget is merely an aggregation of departmental budgets. But there is a further use of the budget in that it affords a more efficient and intelligent outlook into the future. Every part of the company is geared to accomplish a certain result, and, on the basis of this, plans may be made with reasonable certainty of their accomplishment.

The preparation of estimates for the budget naturally leads to greater standardization of manufacturing processes and more careful consideration of expenses.

There has been much waste in the past through uncoordinated efforts.

The budget also affords a basis for comparison with the trend of business and the various barometers, because it shows whether the company is progressing according to its own estimates or whether it is falling behind.

Scope of Budget Idea.—In formulating and applying the budget plan of procedure, certain things must be borne in mind. In the first place, although the budget is contrived to control, it cannot take the place of management. Its purpose is to guide as much, if not more, than to control. It should serve to give the executive information of value in helping him to make his decisions. It should never act as an inflexible bar against the exercise of his own judgment, because, by so doing, it would destroy individual initiative and turn the business into a mechanical operation. This danger also comes up when handling the departmental budgets, because heads of departments must be made to realize that the budget merely points the way, and that if anything comes up which should alter the direction, this should immediately be taken up with the proper authorities.

Like all forecasts and plans, the budget is a prediction as to the future, although this predictive character is given a secondary position. Since all the factors cannot, in the nature of the case, be apparent when the budget is made, there must be ample opportunity for revision when the need for revision comes. It is essential to have reports on budget performance at least once a month and in some cases more often.

On the basis of comparisons, plans may be revised to meet altered circumstances.

There has been and still is a great deal of opposition to the use of the budget, particularly among those who have not been educated as to its advantages, and who look upon it as a barrier rather than an instrument which can be put to good use and profit.

The more simple the master budget can be kept, the more likely it is to prove successful. In fact, the master budget can usually be kept on a single sheet of letter paper. If it becomes too involved, the accompanying red tape will cause too much confusion and expense.

Budget Procedure.—The general procedure in preparing the budget is similar in almost every case, although the details may vary widely.

1. Estimates are prepared of the operations of each separate department of the business for the budgetary period. Each department will have its own form of budget, depending on the nature of its operations. Purely service departments, such as personnel, credit, and office management, will merely present estimates of expenditures. Production departments will present estimates of production and cost of production. Selling departments will prepare estimates of cost of selling and also of estimated sales. It is usual to have estimates of sales prepared in advance of those for production, as otherwise the production and, in fact, the purchasing departments, will not be able to make up their schedules.

2. The second step in preparing the budget is the examination and coordination of the various depart-

mental budgets. This is done by some specified official of the company, sometimes called the budget officer, or it may form part of the duty of the secretary or assistant to the president or perhaps of the controller or president. Estimated receipts are compared with estimated expenditures. If the estimates show that expenditures will exceed receipts, it will be necessary to cut down departmental budgets or to provide additional capital.

When expenditures have to be cut down, great care must be taken to see that revenues are not reduced as well. For example, if the costs of the production department are cut down, it may not be able to produce so much or of an equal quality. If advertising is reduced, then sales may show a falling off also. Under certain conditions, it may be inadvisable to cut down the expenses. In such cases, the only remedy is to find additional capital to repair the deficiencies in income.

It is customary to call the head of the department into consultation when the budget which he has prepared seems to be out of line in any way. At such a time, he has an opportunity to justify his position and to show why he has set his estimates as he has done.

3. The person in charge of making up the budget rarely has the power to confirm or reject it. It must be submitted either to the president of the company, or to a specially selected budget committee, for review and consideration. If the financial policy is seriously involved, the budget may have to be laid before the board of directors. In some companies, such a pro-

cedure is customary. In others, the budget committee takes care of the problem.

4. When the final budget is completed, it will call for a certain quantity of production from the production department, and of sales from the sales department. It will also set an expense rate for each department which cannot be exceeded without permission from the budget officer or from the budget committee. When the budget has been set, it is customary for the head of each department to make a budget of operations for his own use, so that he can achieve the set minimum without exceeding the stipulated expenses. If, for example, the advertising department desires to exceed its set quota, it must make formal application. If sales seem to warrant additional expenditures, then permission may be given, and the budget altered accordingly.

5. As soon as the budget is in operation, each department sends reports to the budget officer at stated intervals which show how estimates compare with actual performance. If this is not done carefully and regularly, the value of the budget is nullified.

The Administration of the Budget.—The budget as a coordinated plan of operation for the entire business requires some method of administration. Careful thought must be given to this, because it is not feasible to allow the budget to be administered by any particular department. Not only would the complaint of prejudice arise, but there would be distrust and jealousy on the part of the other departments.

Methods of administration, as already pointed out, differ according to the size and character of the con-

cern in question. Control may be vested in the president of the company, who delegates the routine and detail work to an assistant. Control in large companies is usually given to a budgetary committee, containing heads of departments and officers of the company. The president of the company is sometimes given the final decision as to the budget, although practice differs. The budget committee usually meets once a month, at which time reports of actual operations are compared with estimates, and heads of departments may present arguments for increases in expense allowances.

It is imperative to have one person responsible for seeing that departmental reports are handed in. While some of the reports may have to come directly from the departments concerned, others may be secured in tabulated form and ready for use from the accounting department.

In some cases, the budget consists merely of a plan of operations laid out by the general manager, executed by the department heads, and checked by the controller. This might well be the case in a small company where all operations were under close supervision.

Length of Budget Period.—The length of the budgetary period will depend mainly on the nature of the business, the method of financing employed, and the type of data which can be secured. In businesses where the data are fairly complete, the budget may be prepared for a fairly long period, such as a year, or 2 years. Where there is less complete information, the budget period should be set at a shorter interval,

such as 6 months, 3 months, or even 1 month. This will prevent too great deviation of actualities from estimates, and the consequent labor of constant revision.

Where there is a pronounced seasonal trend in a company manufacturing throughout the year, a budget for the business must include the entire course of the year, so that fluctuations may be included. In the case of a retail establishment, where there are two fairly well defined seasons, the budget may well be made for a period of 6 months. Where turnover is very quick, and where there is no pronounced activity of one month over another, such as is often the case in retailing necessities, the budgetary period may be even briefer.

To sum up, in a highly seasonal business, where financial requirements are exceptionally heavy at one time of the year and low at another, the budget should cover a long enough period to take in these fluctuations. Otherwise, budgets should be made as short a time ahead as possible so that greater accuracy of estimating may be secured.

If the company is new, and does not, therefore, possess records covering its past activity, it may advisably make its budgetary period at shorter intervals than it normally would until it has had time to obtain some reliable data upon which estimates may be based.

Many companies make a general budget covering a fairly long period and a detailed budget which covers a portion of this. By following this plan, the company secures much valuable experience in forecasting.

There is also much to be said for the continuous budget, whereby for every month which goes by, another month is added to the schedule. This plan is not feasible, of course, unless the business is a fairly constant one, requiring no special financing measures.

Setting Budget Limits.—Obviously, a great part of the efficacy of the budget plan will depend on the care with which budget limits are set. The budget has often been likened to the gas meter which is read monthly, and which shows the exact status of consumption.

In setting the budget, it is necessary to consider:

1. General business conditions. The budget may be enlarged when business seems to be preparing for prosperity. Similarly, it may be curtailed when the period of prosperity draws towards its close.

2. Records of past performance. The records of the company provide an excellent guide for expense and sales budgets. It is customary to add the normal percentage of growth to the figures for the preceding year, or better still, to the average figure for a certain number of years back. This percentage of growth may be altered, of course, by conditions generally.

3. Market conditions. The strength of competition, scarcity of raw materials, or other factors may lead to certain alterations in the budget limits.

Some concerns make careful preparations for flexibility in budget limits. For example, the Penberthy Injector Company sets a minimum and a maximum of business to be done, and then prepares a table of allowable expenses for each department, according to the business actually anticipated for the month. If

the monthly minimum were $120,000, and the maximum $240,000, then the table of expenses would be made up for $120,000, $130,000, $140,000, etc., up to $240,000. An anticipated business of $150,000 would mean, therefore, an expense budget already prepared for each department and for each item. There would be no uncertainty as to how the budget would be apportioned. These expenses are regulated so that the necessary profit will be obtained. Reports are made during the middle of the month to show how the budget is being met.

Graphs and Budgets.—Since one of the most important phases of budgetary procedure is the element of control, it is highly desirable to chart progress in comparison with the quota.

Figure 35 shows a chart used by the Walworth Manufacturing Company to show estimators how accurately their figures were being carried out in actual practice. It also serves to indicate to executives which estimators are most accurate in their predictions.

The chart itself is made in simple form, showing percentages over and under the estimated mark. As can be seen at a glance, in some cases the estimates are very close, while in others they are far off the mark. Cash receipts, for example, have been estimated closely, while cash disbursements have been considerably out of the way. Such items as personnel and payrolls would naturally approximate the estimate closely.

Statistics for Budget Makeup.—The person in charge of coordinating the various departmental estimates must be someone who is familiar with all

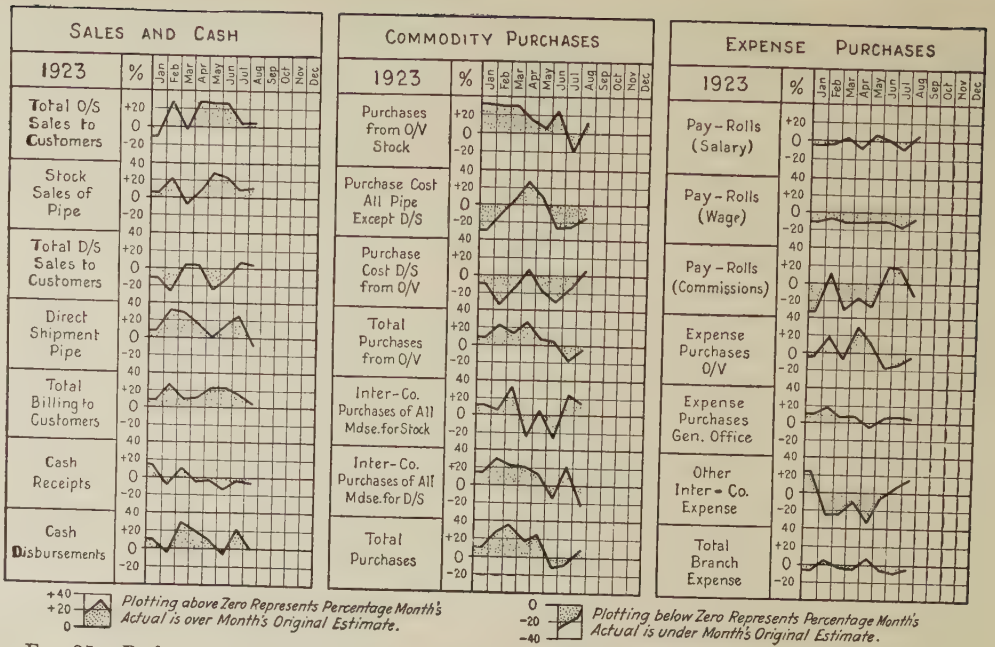


FIG. 35.—Budgetary performance chart showing variation of actual from estimate in percentage. (*Management and Administration.*)

aspects of the business, so that he can take these statistics and form them into a homogeneous whole which will result in net profits to the concern. According to Thomas B. Fordham and Edward H. Tingley of the Delco Light Company (*Management and Administration*), the following information is necessary:

1. Engineering Division. The list of products made and their capabilities. Special adaptations or modifications. New products being designed. Expenses of the engineering work.
2. Finance Division. Details of the financial condition of the business. Cash on hand. Credit rating. Accounts payable. Accounts receivable. Estimates of future income.
3. Manufacturing Division. Maximum capacity of the equipment in the factory to manufacture various schedules of the products. Present used capacity. Detail of manufacturing expenses on a normal operating basis and each month's actual expenses. Material purchases. Labor payrolls. Estimated and actual manufacturing costs of the various products.
4. Sales Division. Detail of the sales territories as to past sales records, percentage of profits made, possible number of prospects, population, best advertising mediums, number of salesmen, selling expense, advertising expense, estimates of future sales, etc. Sales of each product, profits made on each product, sales possibilities and new products being designed.
5. Statistics of general business conditions and future trends.

Without such a knowledge of the business as this, the budget will not reflect the proper balance between actuality and potentiality.

Specific Budget Applications.—In order to show how the budget is applied to various types of business enterprises, the following are given:

The Shur-On Optical Company, of Rochester, N. Y., made a complete analysis for the preceding 3 years,

and established percentages for all activities of the business, dividing them into the following five groups:

1. Material.
2. Factory.
3. Administration.
4. Sales.
5. Advertising.

The budget is in charge of the controller. Estimates must be in by the twenty-fifth of each month, so that the established budget may be handed back to the head of the department on the first day of the next month.

Figure 36 shows how the position of the budget is shown in a form something like a planning board. According to the account in "Budgeting for Business Control" (Chamber of Commerce of the United States), there is a flat box on the wall in the controller's office which divides into two halves when opened, as in the illustration. There is a series of clocks on the left-hand side, each with two hands, a red one pointing to the budget allowance, and a black one set daily at the amount of money spent by each department, that is, material, factory, administration, sales, and advertising.

On the right-hand side, clock *F* has three hands. The one in the inner circle shows the total of the figures on clocks *A*, *B*, *C*, *D*, and *E*. On the outside, a large red hand shows sales for the same month in the prior year, while another pointer shows the total sales this year. Clock *G* compares orders for the current year and for the preceding year.

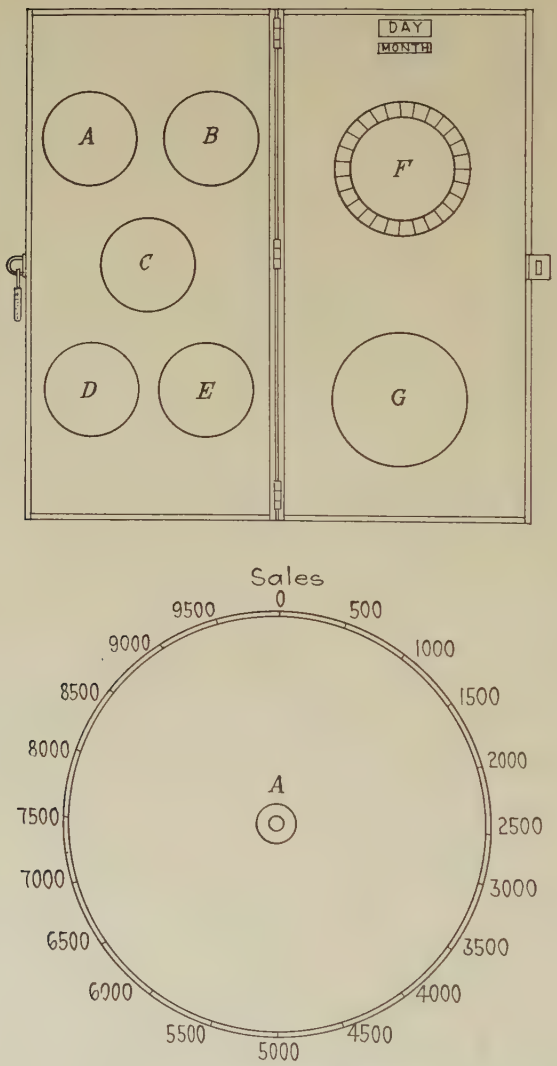


FIG. 36.—The budget clock. (*Chamber of Commerce of the United States.*)

The budget sheet of the Sweet-Orr & Co., Inc., of New York, is reproduced in Fig. 37. This shows the monthly budget performance for the 14 factories, pur-

MASTER BUDGET

Date.....

Classification	*Budget Allowance, May, 1922*	*Expense, May, 1922*	*Balance, May, 1922*	*Budget Balance, June 1, 1922*
Shipments				
Returns and allowances				
Total net shipments				
Purchases material..				
Purchases trimming				
Total purchases..				
Administrative				
Advertising				
Selling				
Warehousing and shipping				
Total distributing				
Factory administration				
Factory building				
Cutting				
Direct labor				
Manufacturing overhead				
Total manufacturing				
Purchasing expense				
Total expense....				

FIG. 37.—(*Sweet-Orr & Co., Inc.*, New York City.)

chases, shipments, selling, and administrative expenses. Separate budget sheets are made out for each one of the departments. Budget allowances are made out in conference between the department head and the

budget committee every 6 months. No changes are allowed in the budget allowance, except that, when actual sales pass the budget allowance, a corresponding excess is allowed in purchases and factory expenses.

In an engineering concern, budget problems may be more difficult.

When the budget plan is applied to such a business as a public utility, it calls for a slightly different arrangement. Here the chief departments for budgeting are construction, operating, materials and supply, and cash.

The construction budget lays out a construction program, and controls expenditures for plant and property. Each operating superintendent reports to the chief engineer, who passes upon the reports and revises them. The undertakings are grouped according to the urgency of the work.

The operating budget includes earnings, operating expenses, and income deductions. The new business department estimates sales and revenue, while the engineering department estimates production and distribution costs. The accounting department takes care of other costs.

The materials-and-supplies budget sets standards for purchases and inventories, and supplies information required by the budget office for preparing the financial budget.

The cash or financial budget shows when and how much money is required to meet the needs of the other budgets. It is prepared by the financial officer and acts as a guide to prepare for financial needs, in addition to giving a survey of the entire business.

CHAPTER XII

FINANCIAL PLANNING

In the last analysis, the prosperity and even the existence of a business enterprise is dependent upon its ability to make money. The financial planning of a concern which always has cash in hand to meet all its demands is, of course, relatively simple, but the majority of businesses do not fall under this heading. Where there is a considerable lapse of time between the initial outlay for raw materials, labor, etc., and the final payment for the finished goods, there is ordinarily a need for financing of one kind and another. For example, where business is seasonal, there will be a demand for additional funds during the period of greatest activity, such loans to be paid off later as the goods are settled for.

If business is increasing rapidly, as during a period of business prosperity, there is a much greater need for short-term financing, and if the company is not careful, it may find that it has become overextended, and its financial position is seriously affected when price declines take place.

In some industries, the business can be conducted in such a way that a safe relation will exist between available capital and planned production and sales. In other words, at some particular time of the year,

the business should have all its loans paid off and have cash in the bank. This can be done in highly seasonal lines, for example, sporting goods. But where demand is comparatively constant, as in most of the food industries, the liquidation may never be entirely completed because of this continuous demand. Here it is customary to establish a minimum ratio between liquid assets and liabilities. Some bankers require a 60- or 90-day liquidation basis.

Function of Financial Executive.—Perhaps the financial man in any organization is the one who is most used to studying the future. It frequently happens that he is administrator of the business and the dominating factor in making major plans for the company. The development of these major plans is invariably based on outside conditions, in which the financial situation is inevitably an important factor. In addition to a knowledge of fundamentals, the financial executive, especially if he is acting as treasurer, will probably be in charge of minor plans. For example, it will be his duty to secure money for the company's needs, and to care for the expenditures, which should be accomplished by means of appropriations, allotments, and budgets.

The budget lays the foundations of the financial road along which the treasurer of the company must take his way. It will tell him the following things:

1. How much money is to be spent.
2. What reserves must be kept for taxes and other fixed charges.
3. What gross and net profits should be, all things being considered.

4. What new developments are under consideration. The treasurer may find that plans call for more money than is on hand or will be on hand. For example, the production department has a new article which it wishes to manufacture. It plans to put out 100,000 of these articles a year, requiring new buildings and new machinery. The treasurer will have to decide how this money shall be raised.

The Financial Budget.—The financial budget provides estimates of cash receipts and disbursements. It covers no standard period. It may cover a year, but often runs for 3 months only.

The financial budget in reality is a combination of two budgets: one for income and one for outgo.

Cash is figured usually from accounts receivable and notes receivable at the beginning of the budget period, to which sales made during the period are added. It is customary to make up a ratio of collections to sales or receivables, so that the approximate amount of cash on hand can be figured. Where collections vary widely from month to month, there may be a monthly ratio.

Disbursements will include maturing notes and due accounts, operating costs during budgetary period, salaries and wages, cost of materials, transportation costs, and all fixed expenses. Dividends and interest will also have to be included, as well as new developments, when such are planned.

The following tabulation shows how a budget of estimated operating statement is formulated, according to D. C. Lowles, auditor of the Cleveland Metal Products Company, and reproduced from the bulletin

of the United States Chamber of Commerce on "Budgeting for Business Control."

BUDGET ESTIMATED OPERATING STATEMENT
Year 1922

Net Sales:

		Per Cent of Total
Class A	$ 8,000,000*	80.0
Class B	800,000	8.0
Class C	1,000,000	10.0
Class D	200,000	2.0
Total	$10,000,000	100.0

Production Costs:

		Per Cent to Sales
Class A	$ 4,800,000	60.0
Class B	560,000	70.0
Class C	650,000	65.0
Class D	160,000	80.0
Total	$ 6,170,000	61.7
Gross margin	3,830,000	38.3

Selling:

		Per Cent
Sales administration	$ 200,000	2.0
General sales department expense	50,000	0.5
Special promotion, etc	50,000	0.5
District operating expense	1,600,000	16.0
Advertising A	400,000	4.0
Advertising B	50,000	0.5
Advertising C	100,000	1.0
Total	$ 2,450,000	24.5
Net margin	1,380,000	13.8

* All figures given, of course, are hypothetical and used for purposes of illustration only.

It is desired to know what the estimated net profits of the business are to be. The following table shows how

net profit may be estimated from operations for the month (*Management and Administration*, Thomas B. Fordham and Edward H. Tingley):

ESTIMATED OPERATIONS, OCTOBER, 1923

Product sales: 40—Product A	.....		
920—Product B			
370—Product C			
250—Product D		$.....	
70—Product E			
200—Product F			
150—Product G			
150—Product H			
Resale materials		.....	
Service sales		.....	
Sundry		.....	
Total net sales		.....	
Less cost of sales		.....	
Gross profit			$.....
Manufacturing division expenses	$.....		
Indirect factory departments	$.....		
	$.....		
Less overhead absorbed by production	$.....		
Less overhead deferred	$.....		
	$.....		
Overhead unabsorbed (or overabsorbed)		$.....	
Selling and administrative expenses		$.....	
Total expenses to be deducted from estimated gross profit			$....
Estimated net profit for October			$....

Various reports are used for making up the budget. For example:

1. Daily reports of customers' orders received.
2. Daily reports of shipments made, compared with quota set for sales division.
3. Daily factory production.

4. Schedules and lists of employees from which payroll may be computed.

Estimates of sales for the coming month are secured from the order department of the sales division, giving the kind and number of products to be shipped, and from this the gross profit can be calculated. By subtracting the estimated expenses, the net profits are obtained.

Department	Total expenses	Cash requirements	Liability incurred	Requisitions from stock and other charges
Manufacturing division...	$118,800	$164,492	$288,530	$12,250
Indirect factory departments.....	21,335	18,035	2,000	1,550
Selling and administrative	108,825	198,305	18,801	4,336
Total.....	$248,960	$380,832	$309,331	$18,136

The total payroll for October should be approximately as follows:

Manufacturing division.....	935 employees	$106,525
Indirect factory division.....	100 employees	16,810
Selling and administrative.....	151 employees	26,795
Total.....	1,186	$150,130

Payroll for September approximately—$140,000.

Condensed Estimate of October Cash Requirements

Cash, as per above budget	$380,832
Liability incurred in September payable October.	190,221
	$571,053

To apply against this estimate of requirements:

Estimated bank balance Sept. 30, exclusive of advanced sale of commercial paper	$700,000
Estimated bank receipts for October	500,000
	1,200,000
October cash requirements	571,053
Estimated bank balance, Oct. 31	$628,947

Advance Estimate of November Cash Requirements

Cash requirements estimated	$400,000
Liability incurred in October payable in November ($309,331)	310,000
	$710,000

Other Forms of Cash Budgets.—While the principle of the cash budget is simply a statement of estimated receipts and expenditures, the requirements of the individual company will necessitate certain adjustments. The following treasurer's budget shows one of the simplest forms (*Administration*, Harry F. Miller, Treasurer of Thomas A. Edison Industries).

TREASURER'S BUDGET*

Cash Estimate, Month of May, 1922

	M Dollars			
	Estimated		Actual	
Balance beginning	....	$ 503	....	$ 503
Receipts				
Receivables	$850	.....	$843	
Income from investments				
Notes payable, discounted				
Blank Bank (due———)	100	950	100	943
Total	....	$1,453	....	$1,446
Disbursements				
Payrolls, 4 at $50	$200	.....	$198	
Payments to Vendors	650	.....	655	
Expenses	40	.....	38	
Accruals, commissions paid, etc	10	.....	12	
Deferred charges:				
Insurance premiums	6	.....	6	
Interest on bank loans	2	.....	2	
Bonds redeemed	100	.....	100	
Notes payable, repaid *X* Bank	100	.....	100	
Notes payable, repaid *Y* Bank	100	$1,208	100	$1,211
Total	....	$ 245	....	$ 235

* Thousands omitted. The figures used in this statement are theoretical, and not representative of any particular business.

The analytic cash analysis is an excellent means of forecasting cash requirements. It is particularly important to know cash requirements because of the difficulty of securing cash during business depressions. Figure 38 shows an analytic cash estimate of the Black-

stone Manufacturing Company, discussed as follows by Raymond W. McKee (*Administration*, vol. 5, no. 4):

Line 1.—Here appear the monthly estimates of net profits which are equivalent to additions to cash.

Line 2.—In July it is expected that notes receivable will increase by the amount of $1,000. This is indicated as a deduction from

THE BLACKSTONE MANUFACTURING COMPANY ANALYTIC CASH ESTIMATE*

July to December, 1922

Line		July	August	September	October	November	December	Net Effect on Cash of Changes
1	Net Income	$4,100	$4,000	$4,300	$4,900	$6,500	$12,000	$35,800
2	Notes Receivable	*1,000*	2,000	*2,000*	*2,000*		4,000	1,000
3	Accounts Receivable	25,000	25,000	25,000	25,000	25,000	25,000	150,000
4	Raw Material Inventory				*10,000*			*10,000*
5	Finished Goods Inventory					*10,000*	5,000	*5,000*
6	Buildings and Sites			*10,000*	*2,000*			*12,000*
7	Machinery and Equipment			*20,000*	*1,000*			*21,000*
8	Furniture and Appliances			*2,000*				*2,000*
9	Notes Payable		*20,000*	10,000			*10,000*	*20,000*
10	Accounts Payable	*10,000*	*10,000*		10,000		*10,000*	*20,000*
11	Surplus						*50,000*	*50,000*
	Net Changes in Cash	$18,100	$1,000	$5,300	$24,900	$21,500	*$24,000*	$46,800
	Cash on Hand, First of Each Month	50,000	68,100	69,100	74,400	99,300	120,800	
	ESTIMATED CASH, CLOSE OF EACH MONTH	$68,100	$69,100	$74,400	$99,300	$120,800	$96,800	
	Cash on Hand, First of Period							50,000
	ESTIMATED CASH ON HAND AT CLOSE OF PERIOD							$96,800

* Deductions are italicized.

ANALYTIC CASH ESTIMATE

FIG. 38.—(*Administration.*)

cash. In August the notes appearing in the balance sheet of June 30 fall due and are considered collectible. This means an addition to cash. In both September and October it is expected that notes receivable will increase by the amount of $2,000. In November no change is anticipated, but in December they are expected to decrease by $4,000.

Line 3.—The largest debtor of the firm, whose financial responsibility was and is unquestionable, is expected to liquidate his

account at the rate of $25,000 per month. This is in accordance with the agreement under which the original credit was extended. Except from this, no material change is anticipated in accounts receivable.

Line 4.—The stock of raw material on hand is to be increased in October by $10,000. The company will allow 60 days in which to pay for the material, and hence the compensating change during the same month in bills payable, as shown in line 10.

Line 5.—The closing inventory of finished goods November 30 is expected to increase by the amount of $10,000, which tends to cause a deduction from cash for the same amount. In December, however, the same inventory will decrease $5,000, with a corresponding addition to cash.

Lines 6 and 7.—The executive committee has decided to enlarge the plant capacity during September and October by the addition of an auxiliary plant. Construction estimates have been made and the orders for the equipment placed. The total cost is to be $33,000, of which $30,000 will be incurred in September and the balance in October.

Line 8.—Additional furniture costing $2,000 is to be purchased in September.

Line 9.—A note payable in the sum of $20,000 falls due during August and will be paid. The construction company erecting the addition to plant has agreed to accept in September a note in amount of $10,000, payable in December.

Line 10.—It is anticipated that accounts payable will be reduced by $10,000 during July, and by a like sum during August. The purchase of additional raw material in October will increase accounts payable $10,000; the account will be paid, according to agreement, during December.

Line 11.—A cash dividend is to be paid during December in amount of $50,000, which will reduce surplus by that sum.

The remaining lines of the analytic estimate are self-explanatory.

Estimating Working Capital.—Too much capital is wasteful, because it involves interest costs for which no return is received. It is even more disastrous, how-

ever, to fall short of working capital. On the assumption that working capital must be sufficient to insure continuity of production during the period required for manufacture, transport of product, and collection of accounts, J. K. Mason, Comptroller of the New England Confectionery Company, Boston, Mass., suggests the following equation (*Administration*):

Let W = working capital required.
E = expenditure represented in the product sold.
D = period in working days covered by expenditure.
d_1 = average period in working days needed for manufacture of the average unit of product sold.
d_2 = average period in working days from shipment to collection of accounts.
d_3 = average number of working days' supply of inventories that must be carried.
d_4 = average number of working days required for replenishment of inventories.

Then:

$$W = \left(\frac{E}{D}\right)d_1 + \left(\frac{E}{D}\right)d_2 + \left(\frac{E}{D}\right)d_3 + \left(\frac{E}{D}\right)d_4;$$

or:

$$W = \frac{E(d_1 + d_2 + d_3 + d_4)}{D}$$

To take an example, what working capital would be required to guarantee continuity of operation in the manufacture and sale of a product representing $100,000 expenditure per month of 25 working days under the following conditions; assuming that the price of the commodity and amount of fixed capital remain unchanged?

Average number of days for manufacture..... 10
Average number of days from shipment to collection..... 20
Average number of days supply of inventories needed..... 30
Average number of days for replenishment..... 10

Substituting the preceding figures in the equation we have the following:

$$W = \frac{\$100{,}000\ (10 + 20 + 30 + 10)}{25}$$
$$= \frac{\$100{,}000 \times 70}{25}$$
$$= \frac{\$7{,}000{,}000}{25}$$
$$= \$280{,}000$$

The expenditure represented by the product averages $4,000 daily. Continuity of operation will require, therefore, that $40,000 shall be kept in process at all times; that $80,000 be in process of collection; that $120,000 be available as inventories; and that $40,000 be in transit from suppliers.

Maximum and Minimum Plan.—In making any financial forecasts, it is advisable to make arrangements for variations from estimates. For example, each division of the General Motors Corporation is required to present estimates of sales, earnings, and capital requirements:

1. A minimum expectation, or pessimistic forecast.
2. Conservative expectation, or what seems most likely.
3. Maximum, with production and sales capacity the limit.

These forecasts cover a period of a year. On the twenty-fifth of each month, definite forecasts for the current month and the coming 3 months are made, covering sales and production. These indicate the amount of investment at the end of each month in the plant, working capital items, and outstanding inventory commitments.

These estimates are passed on by the central office, being compared with current and past performances. Any irregularities are investigated. The company knows fairly well the ratio for working capital required to carry on a certain volume of business. Allowance is made for seasonal fluctuations, as well as trends in manufacturing costs. These forecasts are at the base of the financial control.

According to the Chamber of Commerce of the United States, the maximum plan calls for the establishment of an industry on the basis of the largest possible amount of sales. If these sales, for any reason, run under this figure, then the net profits will be less.

The minimum plan calls for the establishment of the business on the basis of the minimum sales necessary to make a satisfactory profit, on the theory that if sales are larger, the sales force can meet it, and that there can be a 25 per cent speeding up of the entire organization over the normal, with consequent growth in net profits.

The example is given of a concern in the agricultural implement industry, which finds that there is $1.35 of available capital for each dollar of sales. It is estimated, therefore, that the company would require $1,200,000 fully paid on capital stock, with seasonal borrowing, to take care of an $800,000 minimum and $1,000,000 maximum sales volume. From information available, it is figured the capital would be distributed as follows:

	Amount	Per Cent of Available Capital	Per Cent of $800,000 Sales
Assets			
Plant	$420,000	35	52½
Inventory	400,000	33⅓	50
Receivables	240,000	20	30
Cash	140,000	11⅔	17½
Total	$1,200,000	100	150

Liabilities

Capital stock	$1,200,000
Payables, at beginning and end of year	None
Surplus	As accumulated
Reserves	As accumulated

Then the minimum and maximum plans of organization would appear somewhat as follows, according to the estimates of this company:

Minimum Plan

If organized on an $800,000 minimum sales basis, the year's operations would be somewhat as follows:

	Per Cent	Amount
Total cost of operations, including:		
Cost of production	.....	.....
Sales expense	.....	.....
General and other expenses (including taxes)	89.75	$718,000
Interest paid	.....	.....
Net profit	10.25	82,000

Should sales exceed expectation and reach $1,000,000 (cared for in part by reduction of inventory and in part by increased production), the showing would be approximately as follows:

	Per Cent	Amount
Net profit on $800,000 sales as shown above (before taking into account savings as outlined below)	10.25	$82,000
Plus increased earnings due to larger volume on account of:		
Amount saved by having greater production over which to distribute overhead	4.00%	
Having a larger sales volume over which to distribute sales expense	3.00	
Total saving	7.00%	
Deduct possible increase in interest charges incident to increased volume	0.90	
Net saving	6.10%	61,000
Total net profit on $1,000,000		$143,000

Note.—On an increased volume of sales, no saving is estimated on "General and other expenses," but allowance is made for these to increase in the same ratio on the $1,000,000 volume as obtained on the $800,000 minimum.

Maximum Plan of Organization

If organized on a $1,000,000 maximum sales basis, the year's operations would be somewhat as follows:

	Per Cent	Amount
Total cost of operations, including		
Cost of production	.....	.....
Sales expenses, general and other expenses (including taxes)	86.65	$866,500
Interest paid	.....	.....
Net profit	13.35	133,500

Should sales for any reason reach only $800,000, the showing would be as follows:

		Per Cent	Amount
Net Profit on $1,000,000 sales as shown above		13.35	$133,500
Less decreased earnings due entirely to lessened sales on account of:			
Reduced factory operations increasing cost of production through having to carry full overheads on decreased volume	4.00%		
Having to carry a maximum sales expense that could not be reduced in time to make material savings	3.75		
General expense and other expenses that could not be decreased (including taxes) would add in percentage not less than	2.50		
Total decrease in earning percentage	10.25%		
Deduct possible saving in interest, which saving is doubtful	0.90		
Total increased cost of carrying on the business on a sales volume of $800,000		9.35	93,500
Leaving net profit		4.00	$40,000
Net loss in earnings due to decreased volume when maintaining full maximum organization		.....	93,500

CHAPTER XIII

PRACTICAL BUDGETING

The subject of budgeting can be understood best by means of a practical example. Although the individual business will differ in many respects, the following analysis should shed some light upon the method of attacking the problem.

The owner of an office building proposes to make a budget for the ensuing year. The principal aim of this budget is to find out in advance whether surplus funds may be invested profitably, or whether temporary financing will at any time be necessary, and if so, for how long.

There are two factors involved—cash receipts and cash disbursements. Each of these factors, however, is itself the result of a number of minor factors which must be considered in detail.

The owner is aided in his formation of the budget by his past experience as to leases, mortgage tax, and additional data of similar nature. His first task is to tabulate his expected cash receipts.

Cash Receipts.—The cash receipts will not be uniform from month to month because there are two kinds of leases; some requiring payment of rent in advance for 3 months beginning May 1, Aug. 1, Nov. 1, Feb. 1, these leases aggregating $100,000 a year; and some

requiring payment of rent in advance for 1 month and aggregating $210,000 a year. (There may also be other leases specifying different modes of payment, but for present purpose the multiplication of difficulties will not serve any useful end.)

Past experience has shown that 10 per cent of the tenants who occupy offices are unable to pay promptly or rather 10 per cent of the aggregate rental will not be collected in time and may perhaps be lost entirely. Nevertheless, the owner may, and generally does, continue to carry such tenants in the hope that they will eventually pay. Unless it is evident that the tenant will not be able to pay, it may be desirable to permit him to remain in possession of the office so as to avoid the appearance of too many vacant offices. It often happens that if a prospective tenant has the choice of many offices in the same building, he begins to look upon the building with suspicion and ends by going where the crowd is.

Thus, the owner will count upon an income of only $90,000 from the tenants who pay quarterly and upon an income of $189,000 from the tenants who pay monthly. There is then left a margin of $31,000 and perhaps an additional margin of $20,000 worth of unrented space. To avoid further complications, it may be assumed that the income from sources other than rent is negligible.

The expected cash receipts may now be tabulated as follows:

CASH RECEIPTS EXPECTED FROM MAY 1, 1922 to MAY 1, 1923

	May	June	July	August	September	October	November	December	January	February	March	April	Total
Monthly, good	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$15,750	$189,000
Quarterly, good	22,500	.....	.....	22,500	.....	.....	22,500	.....	.....	22,500	.....	.....	90,000
Total expected	$38,250	$15,750	$15,750	$38,250	$15,750	$15,750	$38,250	$15,750	$15,750	$38,250	$15,750	$15,750	$279,000

The obligations that will have to be met must now be analyzed, and the following data are presented for the proper distribution of expected cash disbursements:

1. A number of people must be employed continually and wages amount to $800 a week, but it must be remembered that in some months five pay days will occur and only four in others.

2. The building being equipped with a steam-heating and an electric-generating plant, both products being supplied without extra charge, large quantities of fuel will be necessary. More fuel will be used in the cold months when the days are short, than in the warm months when the days are long. Coal will cost $750 per month from April to September inclusive and $1,250 per month from October to March inclusive.

3. Repairs, supplies, gas, window cleaning, rubbish removal are distributed uniformly over the year and are estimated to come to $1,000 per month. Miscellaneous other expenses including accounting and legal expenses will add $500 per month.

4. Taxes are payable in May and November, $35,000 per year.

5. Water bills are payable in March, June, September and December, $1.600 per year.

6. Insurance premiums will amount to $3,000 per year, and the policies are so distributed that one-half of the premiums are due in June and the other half in December.

7. Commission for collection of rents is 3 per cent of the amount collected. Commission for renting vacant offices need not be considered since additional income will thereby be produced.

8. There are three mortgages: A first mortgage of $900,000 bearing interest at 6 per cent payable in October and April; a third mortgage of $100,000 bearing interest at 6 per cent payable in May, August, November, and February.

9. The second mortgage provides that instalments of $10,000 each shall be paid on the date when the interest is due. Similarly, instalments of $10,000 are to be paid on the third mortgage.

Of course, the interest bills will be decreasing as instalments are paid, but the owner makes a rapid calculation disregarding these differences and estimates that the following disbursements will have to be made:

1. Wages	$41,600
2. Coal	12,000
3. Repairs, etc	18,000
4. Taxes	35,000
5. Water	1,600
6. Insurance	3,000
7. Commission	8,370
8. Interest	81,000
9. Instalments	80,000
Total	$280,570

As he had previously determined that rents may surely be expected to produce $279,000, he feels that, in view of additional income that may be expected from delinquent tenants, the prospects are good and cheerfully begins to tabulate his expected monthly disbursements as follows:

CASH DISBURSEMENTS EXPECTED FROM MAY 1, 1922 TO APR. 30, 1923

Item	May	June	July	August	September	October	November	December	January	February	March	April	Total
Wages	$3,200	$3,200	$4,000	$3,200	$4,000	$3,200	$3,200	$4,000	$3,200	$3,200	$4,000	$3,200	$41,600
Coal	750	750	750	750	750	1,250	1,250	1,250	1,250	1,250	1,250	750	12,000
Repairs, etc	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	18,000
Taxes	17,500	.....	.....	.....	.....	.....	17,500	.....	.....	.....	.....	.....	35,000
Water	.....	400	.....	.....	400	.....	.....	400	.....	.....	400	.....	1,600
Insurance	.....	1,500	.....	.....	.....	.....	.....	1,500	.....	.....	.....	.....	3,000
Commission	1,145	470	470	1,145	470	470	1,145	470	470	1,145	470	470	8,340
Interest, first mortgage	.....	.....	.....	.....	.....	27,000	.....	.....	.....	.....	.....	27,000	54,000
Interest, second mortgage	.....	.....	5,250	.....	.....	5,100	.....	.....	4,950	.....	.....	4,800	20,100
Interest, third mortgage	1,500	.....	.....	1,350	.....	.....	1,200	.....	.....	1,050	.....	.....	5,100
Instalment second mortgage	.....	.....	10,000	.....	.....	10,000	.....	.....	10,000	.....	.....	10,000	40,000
Instalment, third mortgage	10,000	.....	.....	10,000	.....	.....	10,000	.....	.....	10,000	.....	.....	40,000
Total	$35,595	$7,820	$21,970	$17,945	$7,120	$48,520	$35,995	$9,120	$21,370	$18,145	$7,620	$47,720	$278,740

The totals of cash receipts and disbursements may now be combined so as to show the surplus or deficit at the end of each month. This may be done by indicating the total receipts from May 1 to the end of any month as in the following tabulation, where the receipts at July 31 are obtained by adding the receipts for May, June, and July (similarly for disbursements).

The surplus at the end of the month is found by adding to the surplus at the end of the preceding month, the addition to surplus during the month; or by subtracting from the surplus at the end of the preceding month, the deduction from surplus during the month. In the present case, it is assumed that there was neither surplus nor deficit at the beginning of the year, May 1.

The final surplus, $260, is as it should be, the difference between the total cash receipts, $279,000 and the total cash disbursements $278,740. It is also the difference between the total additions to surplus, $76,840, and the total deductions from surplus $76,580.

An examination of the surplus account reveals the fact that surplus fluctuates, reaching a maximum at the end of September and a minimum at the end of the fiscal year. It appears that (since rentals are usually collected before the fifteenth of the month) it would be possible to invest $4,000 on June 15 for 4 months, and the same amount, $4,000, may again be invested for 4 months on Dec. 15. In addition to the above investments, $20,000 may be invested for 2

months on Aug. 15 and a like amount may be invested for 2 months on Mar. 15. Such investments as

$ 4,000 for 4 months,
20,000 for 2 months,
4,000 for 4 months, and
20,000 for 2 months

are the equivalent of $112,000 invested for 1 month.

Thus the use of a budget may enable the operator to plan the investments which will result in additional income and in an increase of the final surplus.

ANALYSIS OF SURPLUS OR DEFICIT

	To May 31	To June 30	To July 31	To Aug. 31	To Sept. 30	To Oct. 31
Cumulative cash receipts	$38,250	$54,000	$69,750	$108,000	$123,750	$139,500
Cumulative cash disbursements	35,595	43,415	65,385	83,330	90,450	138,970
Surplus	$2,655	$10,585	$4,365	$24,670	$33,300	$530

ANALYSIS OF SURPLUS OR DEFICIT.—*Continued*

	To Nov. 30	To Dec. 31	To Jan. 31	To Feb. 28	To Mar. 31	To Apr. 30
Cumulative cash receipts	$177,750	$193,500	$209,250	$247,500	$263,250	$279,000
Cumulative cash disbursements	174,765	183,885	205,255	233,400	231,020	278,740
Surplus	$2,985	$9,615	$3,995	$24,100	$32,230	$260

The surplus or deficit may also be tabulated as follows:

Month	Receipts for month	Disbursements for month	Addition to surplus	Deduction from surplus	Surplus at end of month	Deficit at end of month
May	$ 38,250	$ 35,595	$ 2,655	.....	$ 2,655	
June	15,750	7,820	7,930	.....	10,585	
July	15,750	21,970	.....	$ 6,220	4,365	
August	38,250	17,945	20,305	.....	24,670	
September	15,750	7,120	8,630	.....	33,300	
October	15,750	48,520	.....	32,770	530	
November	38,250	35,795	2,455	.....	2,985	
December	15,750	9,120	6,630	.....	9,615	
January	15,750	21,370	.....	5,620	3,995	
February	38,250	18,145	20,105	.....	24,100	
March	15,750	7,620	8,130	.....	32,230	
April	15,750	47,720	.....	31,970	260	
Total	$279,000	$278,740	$76,840	$76,580		

If it had developed that instead of a surplus, a deficit was to be expected at the end of any month, financing would have been necessary. If, for example, the interest on the first mortgage had fallen due in any month before October, the surplus on hand would have been insufficient to meet the obligation.

The final surplus must not be confused with the net profit for the year. It must be adjusted by adding the instalment payments made on mortgages and by the amount spent for supplies which are still on hand. It must also be reduced by proper charges for

depreciation of building and equipment and, if the company be organized as a corporation, by adequate provision for state and federal taxes.

The procedure outlined above is applicable not only to the operation of real estate but may be extended with suitable modifications to any enterprise whatever.

The illustration of a cash budget for the owner of an office building sets forth in detail the method of procedure. In the case of a mercantile or trading concern, the same principles must be followed.

1. The first essential is to determine the amount of sales which may be expected. A company that has been in business for a number of years is usually guided by what happened in the past, due allowance being made for special factors which now exist. If the sales consisted of a large variety of articles, a forecast can be made of the sales of each article.

2. Sales are made on different terms to different classes of customers: the terms, for example, being

(*a*) cash;
(*b*) 2/10, net 30 days;
(*c*) 1/20, net 60 days;
(*d*) net 90 days.

If the records for the past had been carefully kept and analyzed, the percentage of total sales under class (*b*) where the 2 per cent discount is taken may be determined very closely. The percentage of sales of each class where payment is made by note may also be determined within reasonable limits. Thus it is pos-

sible to foretell with fair accuracy which accounts may be expected to result in cash during each of several months.

It is now possible to draw up a schedule somewhat as follows:

ESTIMATED CASH RECEIPTS

	January	February	March	April	May
Cash sales.....					
Accounts.....					
Notes receivable due..					
Total.....					

The estimated cash disbursements must be considered in the light of the forecast of sales, for merchandise to be purchased will depend upon the amount expected to be sold. There are, however, certain expenditures which are fixed and are not at all dependent upon volume of sales, and these may be listed first. They will consist of such items as rent, interest, office salaries and expenses, advertising, payments to creditors.

Then the variable expenses which depend upon the amount of sales may be taken up. They are: commissions to salesmen, payments for merchandise to be purchased, insurance, freight.

After proper provision has been made for all disbursements that will have to be met, a safety factor may be provided under the caption, Contingencies or Miscellaneous.

The estimated cash receipts and the estimated cash disbursements may now be arranged in some order such as the following:

	January	February	March	April	May
Estimated.....					
Cash receipts.....					
Estimated.....					
Cash disbursements...					
Estimated.....					
Surplus or deficit.....					

The actual cash receipts and disbursements should be written above the estimated figures which were typed; a separate schedule may be prepared to show the actual figures; or the combined schedule may be set up in the following form:

	Estimated	Actual	Estimated	Actual	Estimated	Actual	Estimated	Actual
	January		February		March		April	
Cash receipts.....								
Cash disbursements....								
Surplus or deficit.....								

Each of the original schedules of cash receipts and of cash disbursements should be set up similarly so that

a comparison can readily be made between the actual and the estimated figures.

If there are several different departments, the schedule of cash receipts may be extended as follows:

Cash sales department A.
Cash sales department B.
Cash sales department C.
Cash on account A.
Cash on account B.
Cash on account C.
Notes receivable due.

The problem becomes somewhat more complex for a manufacturing concern but the principle is ever the same. The complexity is eliminated by considering each department separately and preparing a budget of estimated expenditures for each. A consolidation of the budgets of the various departments into a single general budget does not present any difficulty.

CHAPTER XIV

PLANNED PURCHASING

The great importance of prediction as applied to purchasing has been recognized for many years. During times of depression, it becomes particularly noticeable. Many companies find their storehouses filled with materials which have been purchased at high prices, and which have been bought in larger quantities than can be used. Large inventories of unfinished materials have more than once forced companies into bankruptcy or receivership. In some cases, cancellation of orders may save the day, but this is a poor substitute for the farsightedness which every purchasing agent should aim to make a part of his mental equipment.

During hard times, the motto of the purchasing agent is "Buy often and buy light." This may be a good motto at such times for most companies. There are other times when great advantage can be obtained by signing up on a long-term contract. In fact, contracts of this sort are becoming more and more the rule as time goes on. It will be an advantage or a danger according as the signers thereto are able to predict the conditions effected under it.

Prediction as applied to purchasing will include the following phases:

1. The time to buy, as determined by industrial, cyclical, or seasonal fluctuations.

2. The quantity to buy, as determined by the same factors.

3. Sources of supply, based on future requirements as well as present needs.

4. Price, including the question of contracts, dealing in futures, and similar questions.

5. Methods of regulating purchases to internal requirements, or the routine of purchasing procedure. These will include a study of the volume of production, the volume of consumption, and trends.

The Purchasing Agent.—The office of purchasing agent requires a number of faculties. He must act as the connecting link between the outside sources of supply and the internal production demands. He must also be acquainted with the fundamental principles of marketing, and the factors which affect the market, such as the business cycle, the season, changes in the industry, and the like.

The purchasing agent, of course, should be an expert in the selection and specification of materials. But this is not the most essential part of his requirements. He can obtain assistance of a laboratory nature in determining technical points, but he must rely on his own judgment when it comes to determining the time to buy, the amount to purchase, and the correct amount of inventory to keep on hand.

Originally, the purchasing agent's principal function was to purchase materials at the lowest price they could be obtained, everything else considered. In many lines of business, it still holds true that much of

the profit depends on the purchase price of the raw materials, particularly in highly competitive industries where the price of the finished goods is practically uniform for all companies. Therefore, the purchasing agent should not only have a general knowledge of marketing factors, but a particularized knowledge of individual sources of supply and the means of obtaining products at the lowest market price.

In no department of business is the need for a careful system of records more apparent than in the purchasing division. Adequate planning depends almost entirely on a knowledge of facts, both external and internal. Careful records, therefore, are an essential feature of the purchasing agent's equipment.

The Time to Buy.—While the function of purchasing is emphatically not a speculative one, it implies a thorough knowledge of the laws which govern price trends. That is, the purchasing agent must pay the greatest heed to general business conditions and also to conditions within the industry.

Because the prices of raw materials normally fluctuate more widely and are more sensitive to outside influences than those of finished products, the purchasing agent should be well acquainted with the effect of the business cycle on materials which he buys. Particularly when he is tempted to buy ahead in anticipation of a rising market, he should have facts and figures at his disposal.

The Dennison Manufacturing Company works on the following basis: It figures out approximately the maximum and minimum inventories of each important raw material which it is willing to carry at different

phases of the business cycle. The prices of these commodities are charted over a long period, and in this way the general trend is obtained. Above and below the average line on the chart, there are two other lines, called maximum and minimum purchase lines. Actual purchases are measured according to the position of actual prices relative to these three lines. The minimum purchase line shows the smallest amount of inventory safe to carry and the maximum line the largest inventory advisable to carry at any given time. By means of this chart, time and quantity are correlated and, although the results necessarily are only approximations, it serves as a valuable guide.

Seasonal trends are also of the greatest importance in many industries. In such cases, the time to buy, theoretically, is when the seller is most anxious to sell, that is, at his dull season. The efficient purchasing department will take advantage of this axiom, and will plan its requirements so that purchases may be made at such times, unless some other factors are present which make such procedure illogical.

E. A. Filene, in preparing a model stock plan for his store, divides the typical manufacturing season into the following important dates (this, of course, applies to the manufacturer of style goods—one of the most highly seasonal businesses in the country):

1. First showing of high-class samples.
2. Showing of full lines.
3. Busiest season begins
4. Busiest season ends.
5. Between-season showing.

6. "Job" season begins.
7. Season ends.

He believes that the store can make the most money by buying when the manufacturer wants to sell rather than during his busiest season when he is making the most profits for himself. Figure 39 shows graphically how such a policy works out in actual practice. Vol-

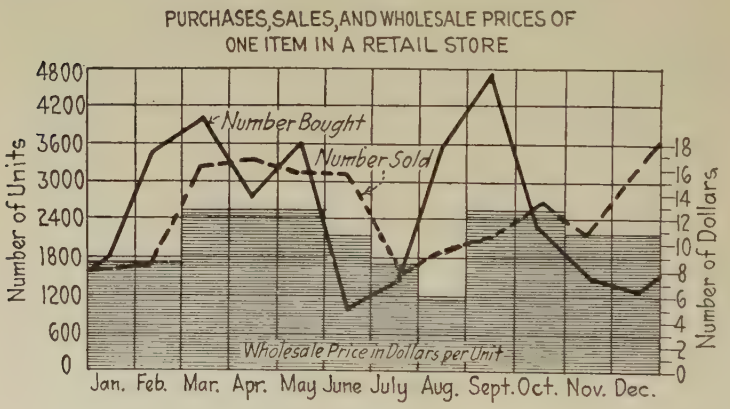


FIG. 39.—(*System.*)

ume of buying tends to rise when the wholesale price is at its lowest.

Being ready to buy when the price is low is, of course, an important factor. Here the inventory system is seen as a most valuable aid to efficient prediction. The purchasing agent, or buyer, watches his inventory to see that it reaches its minimum at the time he is ready to buy. To do this requires an expert knowledge of production schedules and marketing quotas.

Quantity to Buy.—The question of how much to buy is closely related to the time of buying. Theoretically, it would be advisable to buy enough at one period of low prices to last until the next period of low prices. In actuality, there are few, if any, cases where this is possible.

In the first place, there is the question of finance. Will the company be able to invest funds in raw materials in sufficient quantities to carry it from one period to another? Will the interest on the inventory consume all the profits obtained by the purchase at low price levels? Would not such purchases constitute a dangerous policy for the company, particularly if market prices were likely to change at frequent intervals? Furthermore, engineering designs may change and necessitate a different type of product, or in the case of a style product, too large an inventory would mean serious financial loss.

Another factor is available storage space. If raw materials are bulky and have to be stored under cover, this may constitute a serious problem. Still another point of importance is the facility with which shipments of raw material may be obtained. If there is likely to be much delay, resulting in shutdown of the plant for lack of materials for manufacture, it may be advisable to keep a fairly large stock on hand. All these and other factors must be considered in making up the plan for purchasing and in the determination of how large quantities shall be ordered and kept on hand.

In many cases, the most important factor, regulating the quantity of goods to purchase, is the production schedule. In every case, there should be close coordi-

nation between the purchasing and production departments, because the activity of production reflects directly on the quantity of raw materials to be ordered.

Sources of Supply.—The sources from which the company secures its supplies of raw material are worthy of study. In the first place, their location in respect to the company is important. As a rule, it will be desirable to obtain raw products as near at hand as possible, because of the freight rates, and because of the greater speed of delivery. The purchasing agent, however, desires to investigate more closely. He is concerned chiefly with the ability of the selling company to supply him with materials in sufficient quantities, of the right quality, and at the time he needs them. He cannot make satisfactory purchasing schedules if he cannot depend on his sources of supply.

The question of how many concerns to buy from is sometimes perplexing. If he is farsighted, he will not ordinarily desire to limit his purchases to one or even two concerns. He will want to guard against any emergency which overtakes one of his sources of supply. It will not be desirable, on the other hand, to spread his purchases too much because he will not then secure the price savings obtained by buying in bulk.

Although the majority of purchases are carefully specified as to quality and other characteristics by the production department, the purchasing agent sometimes has the opportunity to make real economies by suggesting substitute materials which cost less and are equally satisfactory. A wide knowledge of sources of supply will also enable him to tell in advance as to the available supplies, and in case of

shortage will allow him to secure the company's requirements in advance.

Price Questions.—Obviously, if a company cannot purchase at prices which are as low or lower than those of its competitors, it is placed at a serious disadvantage. It is one of the purchasing agent's chief functions to see that he secures this price advantage. In other words, he must forecast price trends. If, for example, he uses steel as one of his raw material purchases, he should be able to tell the tendency of production and prices in all the contributing industries between the steel and the ore in the ground. He must judge the flow of the raw ore as it is made into steel for him and the other buyers.

If the demand for steel is likely to increase, due to his own orders and those of all other steel users, prices of steel will tend to go up. If the demand diminishes, they will tend downward. Furthermore, if production of steel is easy, cheap, and fast, due to plentiful and easily accessible ore, abundant and cheap labor, free competition, and abundant transportation facilities, the price of steel will tend downward; if the contrary is true, it will tend upward.

The purchasing agent must often allow time for reductions in price to take place. For example, the price of iron ore has fallen, and he expects a fall in steel prices. But how soon will the wave of falling prices affect him? This will depend upon (1) the production period of each process from the mine to him. That is, if it takes 30 days to mine the ore, 10 days to ship it, 20 days to handle and smelt it, and another 30 to make it into steel and put it on the market, then

the rate of flow, so far as production period of processes is concerned, will be such as to bring him a lower rate on steel in 90 days. But the rate of flow is influenced by another factor, (2), namely, goods on hand and in process at each production plant between the ore and the finished steel. In nearly every industry of the manufacturing type, it is possible for the scientific purchasing agent to know tendencies 3 months or even further ahead.

Purchasing, Production, and Sales.—In the economic sense, production includes the three steps of purchasing, manufacturing, and selling. That is, they are regarded as one continuous process. In actual practice, they have come to be differentiated, although it is recognized that the connection between them is very close, and that if close coordination can be effected, the results will be proportionately good.

In the final analysis, manufacturing and purchasing depend on the sales department. Hence a knowledge of sales plans is essential. But the purchasing department must know in addition the exact amount of everything that is to be used in production and the time at which it will be needed. It is customary, therefore, in some concerns, to make up a master schedule which will show tentatively at what time and in what amounts each material will be required. In some cases, purchasing becomes merged with the manufacturing function, especially where the material used has already been partially manufactured and is not "raw" in the ordinary sense of the word.

In order to obtain the greatest degree of coordination, it is desirable for the purchasing department to

know the plans of the company as far ahead as possible, because only in this way can the greatest economies be obtained. Furthermore, some materials may take a much longer time to procure than others, especially when they must be secured in large quantities. Foresight for the purchasing agent is based upon a knowledge of company plans and policies.

Purchasing Control.—Forecasting and planning in the purchasing department is largely on a statistical basis. No matter how excellent the judgment and bargaining powers of the purchasing agent may be, his knowledge and skill must be backed up with an efficient system. Above all else, he must know what the facts are, both inside and outside of the company's own sphere. While no universal procedure applicable to all companies can be laid down, the following data concerning activities outside of the company will, in general, be required for purposes of purchasing prediction:

1. Graphic interpretation of the business cycle. Normally, this would be obtained by using the digested figures of one of the various forecasting services and applying them to the company's own problems. Because raw materials are among the first to feel the effect of a change in business conditions, this knowledge of the business cycle is especially important. It will help to avoid overbuying on a rising market and too much despondency in a period of depression.

2. Data relating to the industries from which principal raw materials are derived. The importance of this second factor will vary with the particular conditions surrounding the specific company. If it

obtains most of its raw materials from one industry, as a woolen mill would do, it would spend a great deal of time in securing data as to wool production, price variations and reasons therefor, foreign exports and imports, and the like. In practically every case, the purchasing agent will make a comparative and exhaustive study of prices relating to the materials which he buys. By keeping graphic charts, he will be able better to estimate what the price will do under given conditions. He should always be familiar with the peculiar conditions which surround the industries from which he derives his supplies, such, for example, as their seasonal character, their proneness to labor troubles, their volume of production, and the like.

The activities of the purchasing agent will always be dependent upon the state of affairs within the company. Lack of attention to internal conditions has often led to overbuying and consequent disaster. The purchasing agent will, in practically every case, require:

1. Inventory of stocks on hand. Where the quantities used of a material are small, a maximum-minimum type of inventory will serve. Where the quantities are large, the opportunities for profit and also for loss in purchasing are correspondingly great. Hence, inventory records, including price paid, should always be at the purchasing agent's service.

2. Records of consumption. An inventory record alone is of little value without some means of recording the rapidity with which the material is being used. Where the business is seasonal, a chart of consumption, arranged by materials or classes of materials, will

give a fairly good index of quantities required. Where the business is fluctuating, as when done on a contract basis, consumption records will be of less value.

3. Orders. A record of production orders on hand is always useful because, taken with the known rate of production, it will give the purchasing agent an idea of what he must prepare for. Here also he must use his knowledge of the business cycle so that he may not buy too far ahead.

4. Planned sales. The tentative selling quota of the sales department, as already mentioned, serves as the guide upon which all production and, consequently, all purchasing, is based.

An Example of Forecasting as Applied to Purchasing.—A certain large company manufacturing specialties sold to consumers and consisting of several small units, into the manufacture of which a considerable number of materials enter, has developed a system for forecasting purchasing requirements.

This company divides its purchases into two main classifications, first, raw materials, and, second, materials which are partly fabricated and which are purchased from other manufacturers. Charts have been plotted over a period of years for the various raw materials which the company buys in considerable quantities, and these charts are reduced to an index-number basis. These charts give the general price trends and may be correlated with other charts indicating various trends in the business cycle. Still other subsidiary charts are prepared which indicate the size of the orders placed, amount of stock on hand, and the amount of mate-

rial used per month. From the various charts, the purchasing agent is able to tell the relative size of inventories at various seasons of the year and the probable requirements. As a guide to the purchasing agent in judging the market conditions of materials, the statistics available from outside sources are also plotted. It is necessary to introduce various data as to production, shipments, stocks, imports and exports, and other factors which might affect the particular raw materials used by this concern.

As in all cases of this sort, the only valuable basis for making forecasts is to base judgment on what has occurred in the past. If it is possible to find a situation in the company's past history which is analogous to the one at present to be met, the same course of action can be used as in the past, provided that procedure was successful, or if necessary it may be modified.

When it comes to purchasing semi-finished products, that is, parts which are embodied in the company's own product, a somewhat different plan is used. Summed up, this plan is to apply to the supplying plants the same principles of planning which the company uses in its own production departments. In other words, for purposes of forecasting, the supplying plants are considered a part of the factory, and their plans are analyzed and built upon in exactly the same way as though they were under the immediate authority of the purchasing company.

The purchasing agent insists upon a complete schedule of operation which must be employed in manufacturing the parts he is ordering, and he even

goes so far as to learn what machines and tools are to be set aside for his particular work. He can then judge for himself whether the equipment set aside and the plans made are adequate, and whether it seems reasonable to believe that deliveries can be made as specified. In this particular shop, as in most manufacturing companies, it is imperative that materials should be on hand in the assembling room at the proper time, since great confusion and expense will necessarily be experienced in case parts are lacking.

In order to check up on this system and to make sure that the plans are being put through as stipulated, the purchasing agent sends one of his assistants regularly to the various supplying plants to inspect what is going on.

This assistant is thoroughly familiar with the facilities of the factory, and the size and daily capacity of each of the machines. He knows how the material is scheduled; what processes it goes through; the unit materials; the likelihood for delays; the labor situation, and the sources of materials which the supplying factory in turn must count upon.

In addition to these occasional inspection trips, the vendor is required to supply a daily statement of progress, showing just what has been done on each order and giving all the details which are necessary in order to tell the purchasing agent whether the work is being carried through on schedule.

This plan has proved successful in this plant and is being developed in numerous directions. It saves innumerable delays which formerly were

encountered due to the fact that certain parts did not arrive in time for assembling, and it also saves the almost equally unfortunate situation of having to order quantities of materials far in advance of the date upon which they are needed for assembly. Thus less room is required for semi-finished stocks and less capital is tied up. The method of cooperative planning thus developed is of value not only to the company which purchases from the supplying plant, but also to the supplying plant itself, since it aids in its planning and makes all its production more efficient.

CHAPTER XV

PRODUCTION

Prediction may be applied to manufacturing operations in two ways. In the first place, production is treated as a whole, and careful plans can be made as to the proper rate of production, all things being considered. In the second place, prediction is applied to the specialized problems of production.

In some manufacturing departments, particularly in the engineering trades, prediction has been highly developed. A great many companies now have planning departments, the function of which is to work in the future. Schedules are made up there and routing of material and prices schemed out. The future is plotted as though on a blueprint.

One reason why production departments have been so successful in planning is that they are dealing more with inanimate factors, which are more closely confined, and hence easier to observe and reckon with. It often happens that the various vital factors can be determined and measured with great accuracy, so that actual production will follow out the plan. For example, in one production problem, the quality of work was found to depend upon:

1. Kind of material used.
2. Character of jigs or fixtures.
3. Sharpness and durability of cutting tools.

4. Quality and design of gages furnished.
5. Condition of machinery.
6. Skill of workmen.

Each one of these factors could be measured with a fair approximation to accuracy.

The first step in planning production is to find out what the factors are which affect the equation.

The second step is to measure these factors, and to reduce them, where possible, to standards.

The third step is to plan out the work, using these standards as a basis.

The final step is to alter plans in accordance with any new factors which may arise to upset the original prediction.

Production Policies.—It is generally admitted that, once a change in business conditions has taken effect, it is too late to profit by it to any great extent. The maximum advantage is reaped by those who have foreseen this change and have taken their measures in advance to meet it. This applies particularly to production. It has been the rule rather than the exception in the past to increase production only after increased demand has been felt, the ordinary result being that ebbing demand leaves the company with large inventory of finished goods and no market.

The problem of preparing for increased production in advance is not always a simple one. In the first place, it takes considerable courage to carry out the additional financing required merely on the basis of a prediction. The advantage is, of course, that construction can be carried out, equipment pur-

chased, and miscellaneous betterments effected at a time when labor is cheap and when money rates have not advanced.

A great deal will depend upon the type of manfacturing in which the company is engaged. There are, in general, two types of production; one repetitive, the other intermittent.

When a company is engaged in repetitive production, that is, where the same product is manufactured with little change, such as automobiles, or buttons, or soap, and is subject mainly to seasonal fluctuations, the relation between material purchased, in stores, and in process will remain fairly constant to the rate of production. It is known just how much of everything will be required for a given period and just how far ahead it must be ordered so that it will fit into the production plan. Increasing the rate of production merely multiplies proportionately the quantities to be ordered.

In the second type of production, the manufacturing schedule is intermittent. While a certain amount of material which is standard may be kept on hand, each job presents itself as an individual problem, and must be planned for carefully.

In a concern where the element of style is at all important, one of the first questions to be answered in making up a production program is as to what to manufacture. In many cases, this is done by making up samples which are submitted to selling houses, and on the basis of their decisions, preliminary orders are made up. The main manufacturing program is laid out on the result of the reorders. In such a

type of manufacture, it is exceedingly difficult to foretell what the decree of fashion will be or to make advance plans.

A further distinction should be made between an industry devoted to the production of what are termed necessities for which a market may always be found, and an industry devoted to the production of luxuries or novelties. To be sure, some luxury products are always marketable, but, in general, when business conditions are poor, luxuries are the first items for which demand is reduced. In such industries, the condition of business is almost a controlling factor in rate of production.

Elements of Production.—Production within the plant depends mainly upon three factors:

1. Labor, or the personal element.
2. Machinery, or the mechanical element.
3. Materials.

Of these, labor is the most variable factor, and until recently it was regarded as an extremely difficult factor to predict. Recent investigations, however, have established the fact that labor can be made a controllable element to a considerable extent.

In the ordinary type of production, inert machinery is employed to second the skill of the individual worker. A skilled metal worker can drill a hole in a steel plate almost exactly as the inventor or the designer wished to have it, but even the most careful measurement will not enable the metal worker to repeat the operation on another plate without some deviation from the result first obtained. If, however,

a suitable jig or templet is used, the operation of drilling the hole in a special place on the plate becomes so simple that great personal skill is no longer required. The machine enables the unskilled worker to produce results as good as, or better than, those produced by the skilled worker who did not use such devices. The most complex operations can now be performed by means of machinery. The importance of this truism lies in the fact that machinery is a controllable factor in prediction.

Forecasting in production dates from the investigations made by F. W. Taylor concerning the productive power of machinery. He was able to predict the exact number of seconds required to drill a given number of holes of definite size in a piece of metal of given quality and thickness. The prediction thus made depends upon the mechanical properties of the machine, and variations from the predicted result will be large only if important factors, such as defects, have been overlooked.

Such prediction as the above can safely be left to the engineer who makes his laboratory experiments and calculates the results that should or that can be obtained.

Prediction and Machinery.—Every prediction has three parts: first, the immediate observation of facts; second, the formulation of principles learned from the sum total of previous experiences along similar lines, and, third, the application of the principles or the actual prediction. As aids for prediction, every business should keep a record of its observed and verified facts so as to confirm or modify the principles that it

accepts as true. Also the greatest of care should be taken in the observation of facts to insure accuracy, and so that no essential fact escapes notice either qualitatively or quantitatively.

Nowhere are these principles better illustrated than in connection with the mechanical means for production. The mechanical materials with which the establishment works, *i.e.*, tools, machinery, etc., can be standardized and their performance foretold with great accuracy. Good prediction theory simply holds that if a careful and consistent set of performance records is kept, or if proper test experiments are made and checked from time to time, the performance of any mechanical thing can be predicted. Furthermore, depreciation can be calculated.

The performance of machines can be determined by the laboratory tests conducted according to the method of differences, the method of agreement, the joint method, or the method of residues.

1. The method of differences is used as follows: A machine is operated and the results are noted. Parts of the machine are removed or replaced by other parts and the results of operation are again noted. A conclusion may then be reached as to which type of part is more satisfactory. This method is used when conducting tests as to the varying merits of a number of competitive appliances.

2. The method of agreement is somewhat similar only, instead of different parts, the machine is operated under varying conditions. The behavior of the machine is noted under each set of conditions and the points of similarity checked.

3. The method of differences and the method of agreement may be combined, the result being known as the joint method.

4. The method of residues is really a process of elimination. A machine is operated and certain defects are found. A part of the machine is modified and still no change in the defective operation can be noted. By this method of elimination the faulty part is finally found.

While performance of the machine in good condition can be predicted by experimental methods of induction, there remains the question of how long and how continuously the machine will act in a way similar to that shown by the original tests. Here the statistical method is used. A record of hours of use, results, etc., kept over a period of several months, will develop for each type of machine a "performance curve" so that the executive can forecast the performance not merely for any one day or week but for long periods. If the plant is large, and if there are many machines, the average performance can be predicted with great accuracy.

In forecasting machine efficiency, it is customary to allow a certain percentage for error and accident.

The Personal Factor.—The most variable factor in production is ordinarily labor. Yet in many cases this can be standardized and systematized with resultant advantages to the laborer as well as to the employer of labor, and, as a consequence of this standardization, the result of operations within the plant, that is, the output, can and does become subject to prediction. The average daily labor efficiency for

any plant, over a long period, can be foretold with satisfactory accuracy, and, in a large establishment employing thousands of people, it can be foretold with almost absolute accuracy for any day and for any period.

As in the case of machinery, labor can be analyzed and measured according to standards of production. This is done by means of time and motion studies. By carefully watching the steps in a particular operation, and then timing them with a stop watch, a fairly accurate picture is obtained. It is customary in some cases to have time and motion studies made by two different observers so that there may be less error in results.

As a result of motion studies, it frequently happens that a number of motions can be eliminated and the efficiency of the whole process increased. It is now an established fact that the amount of work that can be turned out by a given machine, operated by a workman of average intelligence who has been taught how to utilize the machine, may be predicted within narrow limits.

From the point of view of production, the laborer must be regarded as a machine which can be controlled, and not as a social being subject to whims. What can be accomplished by the statistical method of approach is shown by the following results of time-and-motion studies of an assembling operation (reported in "The Sphinx Talks," Miller, Franklin, Basset & Company). The net result was a saving of 38 per cent per man. The detailed results were as follows:

1. Instead of having different men do operations 1 and 2, they were combined and done by one man, which was faster. This was because operation 1 did not take so long as operation 2; therefore the first man would work slowly so as not to get ahead of the second one and pile up a lot of work ahead of his companion worker. Subdivision of operations often pays on a very large volume of production, but on a comparatively small volume it may be expensive.

2. New assembly benches were provided which place the various parts and tools most conveniently for the men.

3. A device on the bench holds the assembly, thus releasing the man's left hand and enabling him to use it for tightening nuts, etc. instead of for holdng the assembly upright.

4. This also reduced fatigue, for the assembly weighs about 4 pounds. Lessened fatigue increases production.

5. It had been necessary to drive the bolts into the holes. Increasing the diameter of the holes $\frac{1}{32}$ inch made the bolts fit easily, saved the time required for driving, and prevented the occasional spoilage of a bolt which resulted from driving.

6. Well-designed stools of the right height, with backs, enabled the men to work with more comfort and less fatigue. That automatically increases the speed even of a man who is inclined to soldier.

The Forces of Production.—The forces used in production are almost entirely controllable and measurable, whether in the shape of muscular power, wind, water power, steam, electricity, etc. Laboratory tests furnish the data for the prediction.

Forces which result from the action of gravitation are measurable with great exactness and, therefore, the force resulting from water falling through a given height and the force resulting from any other form of matter such as a solid object, falling through a known height, are predictable. The laws governing steam pressure and electric potential are also measurable,

and predictions can be made accurately when steam or electrical power are the forces involved.

Materials entering into production have known physical properties which are the basis of predictions. These, also, are ordinarily determined by means of laboratory tests. For example, the tensile strength of metal is determined by test; the number of threads per unit area of textiles is counted; or soap is submitted to chemical analysis to determine its qualities.

The Factor of Safety.—All the elements of production having been taken into account, the predictor can say definitely that, with properly taught laborers, operating machines of a certain type and driven by given forces, a definite amount of a particular product can be produced from a known quantity of some specified material. After having made the calculation, it is usually modified to allow a margin of error of a certain percentage. This margin of error may be called the safety factor. The smaller the margin of error can be made, the more valuable the prediction becomes.

From the nature of the case, unexpected difficulties are constantly arising in production. Unlooked-for defects in machinery or material may come to light. As in the case of engineering work, the factor of safety is a compromise between a desire for safety on the one hand and for economy on the other. The more accurately the data are known, the smaller need there is for the safety factor without sacrificing either safety or economy.

Experimentation and Development.—The large manufacturing concern, and even many a concern of

moderate size, conscientiously sets aside a definite sum for research work. It hopes in this way to find better methods of production, to procure the utilization of by-products, to investigate the claims of new materials or inventions, or other goals of a similar nature. Such research work, although apparently fruitless for a period of years, more than pays for itself when something of definite commercial benefit is discovered. It also serves to keep the company in the forefront of progress in its particular industry.

This research work has a profound effect upon company policies and plans. The company's entire program may have to be changed as the result of some discovery made in the research department. In some of the larger concerns, the research department carries its work to such an extent that it plans the production and marketing of the product which it invents. When embodied in a report, these plans are filed away against the time when the company may desire to put the product on the market.

In other companies, great stress is laid on developmental work, for the success of which careful advance planning is necessary. Each factor is laid out and planned for in detail so that when the time actually comes to develop the product, there will be no delay.

The Production Budget.—The application of the budget to the production department is in line with modern business procedure. For successful operation, this will require:

1. Standardization of processes. By careful tabulation of statistics, the production department should

be able to tell exactly what materials will be required, how long the operation should take, and what it will cost, for any given period of time and for any given manufacturing operation. In other words, the production department must be able to estimate accurately concerning its own operations.

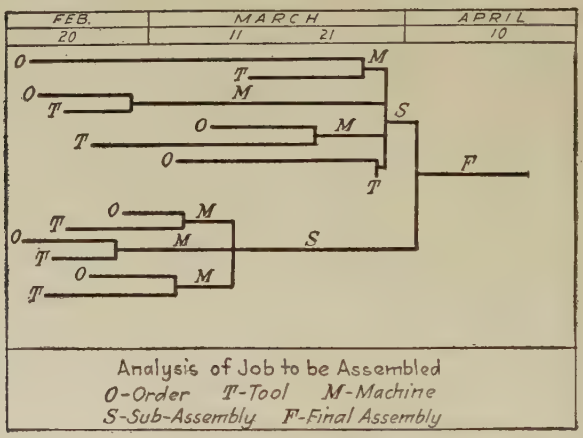


FIG. 40.—Chart analysis of job to be assembled. (*Gilman, "Graphic Charts for the Business Man."*)

2. Planned operations. Scientific management has brought with it the scheduling and routing of work so that one operation will not interfere with another, and so that the whole process will move along logically to its conclusion and not be held up for lack of material, equipment, or power (see Fig. 40).

3. Costs. While overhead charges will remain the same, there are a number of variable charges in production which will differ according to the quantity

manufactured and other factors. These must be carefully estimated and set down in the budget.

4. Complete correlation with the work of other departments. The budget of the purchasing department will naturally depend upon that of the production department, which will give it quantities, qualities, and the time when materials will be required. The production budget, in turn, will depend upon the estimates of the sales department. It is particularly important that any falling off or increase in sales should be reported at once to the head of the production department. This information will allow him to adjust his schedules to meet the new conditions. This also holds true when there is to be any change made in the product, even of a minor nature. Such an alteration may require some radical change in the set-up of machinery or in the type of materials used.

An Example of Prediction as Applied to Production.—In a certain shop where the product is made largely from structural iron and other materials of that nature, and where the product is likely to be changed to a considerable extent with every given order, it is of primary importance to make predictions and to make them with a fair degree of accuracy. The estimate must agree closely with the actual cost of the job, and in this particular case a method has been developed which brings an agreement which is very satisfactory. The difference does not exceed 5 per cent as a rule, and almost never exceeds 10 per cent.

The plan used in this shop is that of projecting the work into the future by a period of time sufficient for

the completion of the job, and of taking every step which must be taken as the job proceeds in keeping track of the cost.

In other words, the estimator uses the accounting system which is in vogue throughout the shop and keeps costs by precisely the same method. He imagines that the job has been done and then enters the hypothetical costs as nearly as they can be predetermined.

It is of particular value to use the regular cost accounting system, because, when the job is done, the estimate may be compared item for item and amount for amount with the cost entries of the actual job. Only in this way, of course, can the technique of estimating be perfected.

It is not possible to carry out this plan to the minutest detail, because that would involve an expense for estimating which would not be justified. It may be necessary in this particular business to figure on eight or ten jobs before one job is obtained, and it is not expedient to carry the cost-accounting plan to such a fine point that the estimates shall be strictly accurate. It is better to make an approximately accurate forecast of costs and then to add a factor of safety of 10 per cent, which would cover any possible errors.

As far as errors are concerned, however, they are for the most part compensating rather than cumulative. If one item is figured too high, the next will doubtless be too low, and the differences will tend to balance each other.

It stands to reason that the estimator, in addition to his accounting experience, must also have a fairly

thorough knowledge of the technical processes which are involved in the work of this particular shop. He must not only know how the job is going to be carried on, but he must be able to read the blueprints and specifications and get a thorough conception of the whole undertaking within a comparatively short space of time. With this as a basis, he will be able to figure the unit cost of the materials which have to be purchased, and in this particular case these will represent a fairly high proportion of the cost of the job. His next problem is to figure the average labor cost per hour for the work in each of the departments through which this particular job has to pass. Then again he makes a suitable allowance for the cost of certain semi-finished parts which are kept in stock in the shop and which are accordingly fairly easy to figure.

To some extent the usual short-cut methods developed by estimators are used here, but only for minor jobs. For instance, one short-cut method is to calculate the number of rivets for a given job by the quantity of steel which is used on that job, or by the number of structural bars which are required. For an item of comparatively low cost, this method is satisfactory. In the purchase of materials, it is necessary to figure current market prices plus additional charges for freight or express, and these items are always allowed for, since in the aggregate they may represent a considerable sum. Where it is possible to predict fluctuations in market prices, allowances are also made for them.

The difficult task of predicting labor costs has been largely overcome through the careful standardization

of time-study data. This shop is operated on a bonus system of wage payment, so that the cost per unit is more easily computed than in cases where wages are entirely based on an hourly rate.

It is necessary, however, to predict with considerable precision the actual number of hours that the job will be in the shop, since in this particular case the overhead is reckoned on the basis of labor-hours, and as overhead is a factor of considerable importance in this type of work, no great error can be tolerated.

It has been found that this method is satisfactory in this shop, but refinements are constantly being made. The system gives more accurate results if the estimate is accurately checked both in the beginning and after the job is finished.

Great care has to be taken to include every possible item of expense, since the omission of a single item might take away all profit.

The estimator is fully conversant with the price policies of the company, and in fact he is the man who determines the margin of profit which must be allowed for. A certain percentage is added to the cost, and the result is then reviewed to see whether it is in line with the competitive prices and whether it seems reasonable to other executives to whom the matter is referred.

CHAPTER XVI

MARKETING

Marketing, or the process of distributing the manufactured goods to the consumer, is becoming more and more a predictive function. Every business must have some quantitative estimate of sales for the future, if only to serve as a basis for production and purchasss. These sales estimates must be based on a study of markets.

The predictive phases of marketing may, in general, be divided into the following classes:

1. *Market Predictions.*—The company will endeavor to determine the actual and the potential market for its product or products. The actual market is required for making plans for the present year; the potential market is needed for the formulation of the sales policy of the future. It accomplishes these predictions by population studies, purchasing power research, or the use of some arbitrary index or indices to determine the absorptive potential of the market. One of the more difficult parts of such research is the estimation of the specific market for the company's product. This entails a study of competition in all its aspects, and the careful and unbiased estimate of what the particular company should be able to accomplish in the way of sales, all factors being considered.

2. *Sales Quotas.*—Sales quotas are based on market studies plus correlation with the various external factors which affect temporarily the sales situation. Sales quotas should be formulated both for fairly long periods and for the coming campaign. The former will help to measure the progress of the company over a period of years; the latter will formulate the schedule for the coming year or even a shorter period. Quotas will normally be subdivided according to the products which the company makes, the districts in which it carries on its sales activities, the type of customer, or other classification.

3. *Distribution Channels.*—The market analysis and the sales quota require a careful study of distributive channels, and a definite distributive plan, if they are to be realized with complete success.

4. *Merchandising Methods.*—The final phase in marketing is the methods used to merchandise the product. The company studies the use to which its products are put, the type of people who use them, the motives for initial purchase or for repeat purchases, and other psychological aspects of the sales problem. By means of tests and experiments, the company ascertains what sales arguments carry most weight, or what advertising appeals are most potent.

The Market Index.—In making a quantitative or qualitative prediction as to the market, the ordinary method is to search for some set of available statistics which will serve as an indicator, and which will bear a certain ratio to the sales of the product in question. Sometimes one index will be taken as sufficient, but more often a long list of indices will be

used, some of which are given more weight than others in forming the final calculation.

The manufacturer of a semi-luxury estimates his market (*Printers' Ink*) according to the following indices:

1. The number of persons in each sales territory reporting over $1,000 income.
2. The average income in each territory.
3. The number of automobile registrations—passenger cars.
4. The proportion of dwellings equipped with electric light and phone.
5. Expenditures for luxuries, estimated from excise taxes.
6. Magazine circulation.
7. Interest in education based on the expenditures for education and the attendance at schools.
8. Percentage of foreign-born population and percentage of rural population.

Income figures and statistics as to passenger cars registered are given more weight than other factors.

The above indices may be compared with those used by a motor truck company (*Printers' Ink*):

1. Population.
2. Estimated sales expense.
3. Minimum volume of business required to absorb expense.
4. Percentage of total truck sales made by your organization during preceding year.
5. Volume of business each preceding year.
6. Average annual percentage of increase.
7. Estimated increase for coming year.
8. Estimated number of sales through old distributors.
9. Estimated number of sales from new dealers.
10. Quota.

Here the major emphasis is laid on actual statistics of sales accomplishments made by the company.

The qualitative estimating of markets is usually done by means of some set of statistics which will eliminate those who would not logically be prospects for the company's products. Thus the market for automobiles is limited by the purchasing power of the individual, by the condition of roads in the locality, by the climate, and by a variety of other factors differing in each district. The total potential market is not exploitable until roads are built, existing highways are kept open in winter, or obstacles of other nature overcome.

The Eastman Kodak Company has built up a market index on the basis of the following factors:

1. Number of persons reporting income over $1,000.
2. Average income, obtained from the *Distribution of Income by States in* 1919, published by the National Bureau of Economic Research.
3. Automobile registrations—passenger cars.
4. Proportion of dwellings equipped with electricity and telephone.
5. Expenditures for luxuries and pleasure, estimated from the excise taxes published in the *Annual Report of the Commissioner of Internal Revenue.*
6. Magazine circulation.
7. Interest in education, based upon (*a*) the expenditures for education and (*b*) the relation of the daily average attendance at school to the total number of children between the ages of 5 and 18.
8. Foreign-born population.
9. Rural population.
10. Scenery and resorts.

Number 4 is reduced to a per-dwelling basis. With the further exception of No. 10, the rest are reduced to a per-capita basis. Index numbers are then computed

for each factor in each state, and a weighted index number is made for all the factors combined. Income and automobiles are given more proportionate weight than the other factors. An especially good correlation was found to exist between automobile owners and Kodak owners. This fact was established by means of a field survey.

Forecasting the Future Market.—All the company's plans are based on a forecast of the business of the future. The analysis of the present market is only a means whereby the future market can be estimated. Obviously, in many cases, this is an extremely difficult problem because the forces acting upon the company are so diverse and so numerous. In some cases, however, companies have been able to look ahead for a period of years, and to make preparations in advance for the business of the future. This is the fortunate position of the American Telephone and Telegraph Company, which has done an immense amount of pioneer work in determining future demand for its product.

According to E. L. Stone, Jr. (*Harvard Business Review*), the analysis of the future market involves five steps:

1. An estimate of the future total population at certain dates, which are, for telephone engineering purposes, generally about 6, 12, and 20 years hence, and an estimate of the local distribution of the total population figures. Each community is taken as a special entity because the causes which lead to population growth, such as excess of births over deaths, or the attraction of population from outside sources,

vary in each case. The normal increase in population can usually be estimated accurately, but the influences which attract population, such as increase in business due to development of tributary territory, attractiveness to homeseekers, or increase in industrial development, are difficult of estimation. A knowledge of the trend of industrial expansion is the most important factor. How this would appear for a rapidly growing community is illustrated in Fig. 41.

Date	Total Population	Decade Increase	Natural	Decade Increase Due to Tributary Territory	Industrial Expansion	Other Influences
1890	65,000					
1900	130,000	65,000	5,000	54,000	3,000	3,000
1910	170,000	40,000	10,500	21,500	5,000	3,000
1920	250,000	80,000	17,000	10,000	49,000	4,000
1930	350,000	100,000	25,000	8,000	61,000	6,000
1940	450,500	100,500	35,000	8,000	50,000	7,500

FIG. 41.—Growth of a community. (*Harvard Business Review.*)

2. A classification of the population assigned to each market section at a future date or dates. This is accomplished by grading the existing residence market, first, according to type of quarters (private residence, flat, apartment, lodging house, light housekeeping) and, second, according to the rental class. Each market section is then examined in the light of classification of families there at the time and the families to be expected there at some future time.

3. An estimate of the total number of business firms to be expected in each of the business classes. Busi-

ness firms have been found to increase in almost the same ratio as population, although there are local differences.

4. A forecast of the changes that will probably take place in each city block within the general business section with a resulting picture of what each block will have at a future date or dates. This is determined by actual inspection of the locality and a forecast of development by an expert. His personal judgment is correlated with local information as to real estate trends, building restrictions, city plans, future transit probabilities, and the like.

5. An estimate of the number and classification of neighorhood business firms in each residence market section at a future date or dates. Neighborhood business developments are treated as local problems.

All these data have enabled the company to make preparations in advance for business increases which they have forecast.

Coordination with External and Internal Factors.—The sales quota must be carefully coordinated with all the external and internal factors which have a bearing on the situation. The considerations which affected the sales quota of the Walworth Manufacturing Company during 1923 were forecast as follows:

1. Building in 1923 will not greatly exceed 1922 levels.
2. Industrial repair and replacement activity will increase somewhat.
3. The oil industry will show increased activity, stimulating sales.
4. Railroad and shipbuilding activity will parallel the activity of business in general.

5. General foreign conditions will not be markedly improved over 1922.

6. Domestic business in general is destined to continue improvement during the greater part of 1923.

Further specific considerations pertain more directly to our own merchandizing organization and policy:

7. The high point of our business cycle in 1923 will probably be reached in July to October—later than in many similar years with which we have compared it.

8. We have more branches and more retail distribution than formerly, and the result of the retail distribution is to feel the cycle less acutely and to lag behind in reaction to the general trend.

9. We have added and are adding to our branch lines other than Walworth items, and the increased diversity of product should enable continued pressure on the lines that are still selling.

10. The price level is higher than in the prewar years considered, and a greater percentage increase in dollars would result from a percentage tonnage increase equal to the percentage tonnage increase attained in the previous years considered.

11. The years considered scarcely reflect in any way our growing export business. The cycle upon which we are now proceeding is of domestic business only. It is proceeding ahead of sound foreign recovery. The decline in the domestic cycle possible in late 1923 and in 1924 may be in the face of continued improvement of foreign conditions; in fact, it may be merely a readjustment to the improving level of foreign conditions. If our foreign trade should only partially "come back" in 1923, continuing probably on its ascent even though domestic business begins a decline, it would be a factor in determining a 1923 average sales level higher than 1922.

Sales Quotas.—Sales quotas, for purposes of prediction, should be quantitative. But there is some disagreement as to what standards should be set. Some authorities argue that quotas should be set at a figure higher than a reasonable accomplishment on the ground that incentive is given to the entire organi-

zation to meet this quota figure. Other authorities contend that it is better to make the quota figure low so that the standard can surely be accomplished.

As pointed out by merchandising experts, there are several types of sales quotas. First, the quota which merely sets a task for a salesman is naturally nothing more than a prediction of that salesman's individual ability to make sales in a particular territory. His ability will be measured by the amount of sales he makes over those which would normally accrue from that territory.

The second type of quota is the mark set for the coming year, half-year, or other sales period used by the company. This is the amount of sales which the company has decided, all things being considered external and internal, that the sales force should make.

The third type of quota is an estimate of the sales which the company can secure from its markets by the use of the best methods. It is the ultimate aim towards which the company is progressing. It forms the basis of the sales policy rather than of the immediate sales program. It is based on statistical compilation and is an estimate of potentiality rather than actuality.

The best method of allotting a current sales quota is in dollars and cents, if this is possible. The Bassick Manufacturing Company, makers of Alemite products, studies car registrations by states, cities, counties, and towns, and then determines the amount of business done per automobile during the preceding year. In one year, for example, Alemite products averaged 50 cents for cars other than Fords. This gave the com-

pany a definite basis for establishing its quota for the following year.

It is important to classify sales by commodities if the company makes a number of lines. In this way only can the budget of sales be apportioned correctly. When a company makes several lines, some of them grow faster than others and meet less sales resistance. This factor must always be taken into account. Each product should have a quota, the sum of all the individual quotas forming the quota for the business as a whole.

An average price for the product must be set so that value of sales can be reckoned for use in the financial budget. This may be done by studying past records and correlating with business conditions.

After quotas have been apportioned according to the product and to the particular item, it is necessary to allot them further according to the various territories and to the amount each territory can be expected to absorb. In each company, there will be special factors to be studied in connection with the territory—those factors which have been found to influence the sales of the product. A luxury, a necessity, a convenience article, or a shopping line will all have special problems to be solved in connection with territorial allotment of quotas.

If a company has a field organization, it may assign district quotas, and then allow the district manager or branch manager to divide his quota among his subordinate offices.

The Distributive Channels.—One of the most important steps in formulating the marketing plan is

a study of distributive channels. This will include a study of possible outlets, the agencies which supply these outlets, the custom of the trade, the comparative expense of various methods, and a multitude of other considerations. The problem is particularly important, of course, where the product is just being put on the market. The success of the company may depend upon the method of taking care of the distribution of the product.

The United States Radium Corporation found that it had to make its market before it could sell its product to manufacturers of radium-treated articles. The field was mapped out carefully as follows:

1. General public. Magazine advertising was carried on, news articles were run in papers, and booklets were sent to any who were interested.

2. Manufacturers. These were divided into present customers who were benefited by general advertising, trade-paper publicity, and direct mail efforts, and prospects whose products offered an opportunity for radium treatment. These were invited to send samples so that the laboratory could work out the proper application.

3. Jobbers. These were stimulated by advertising. Particular attention was paid to jobbers' salesmen because 90 per cent of sales were made through this channel.

4. Retailers and clerks. It was found essential to educate retailers and their clerks so that they would be able to answer the questions of customers. This was a difficult task because dealers were in many lines of business.

Merchandising Methods.—Prediction is gradually being applied to merchandising methods, particularly to advertising. Such prediction is based on an intensive study of the product and of the market. The result of such an analysis should determine the advertising theme, the style of copy, the type of art, and the choice of media.

The application of scientific planning to the advertising expenditure has long been a subject of careful study. There are few companies which spend an arbitrary sum for advertising, unless they are starting in to merchandise a new product, or preparing to inject new life into an old one. The usual practice of establishing an advertising budget for expenditures is to base it on a percentage of sales, either for the previous year, or for an average of a number of years back. It is also a frequent practice to spend a fixed amount per unit of sale. The planning problem has come to be the determination of what the percentage or amount per unit should be.

H. S. Gardner, president of the American Association of Advertising Agencies, describes in *Printers' Ink* how the manufacturer of a gas range would go about fixing his advertising appropriation. His market is limited to communities where gas is used, and women are found to be the ones who select the range. Since the range is high-priced, only a certain number of women will be logical prospects. The number of these is determined by income-tax figures. The manufacturer, therefore, knows approximately how many logical customers he has in each city or town. By charting circulation of media, he determines those

which will cover his market to best advantage. Because a stove is bought infrequently and represents a considerable expenditure, enough space must be used to give a strong selling message. The time of purchasing gas stoves is between Apr. 1 and Nov. 1. Therefore, advertising should appear most frequently during these active months.

The gas-stove manufacturer makes 50,000 stoves a year, and appropriates on the basis of his analyses $100,000, or $2 per stove. If his sales increase to 60,000, he raises his appropriation automatically to $120,000.

By following some such process as this, the manufacturer can determine in advance the amount of advertising which he should spend and not leave it to guesswork or approximation. This will do a great deal towards cutting down the waste in advertising which has been so prevalent in the past.

An Example of Sales Forecasting.—The statistical department of one of the large film companies, after analyzing a large number of film-rental histories, learned that the average earning life of a film is about 2 years. This figure was found to hold true in a large percentage of cases. (*Management.*)

Statistics showed another fact long recognized by film men, that most successes are so elusive in quality, and so ephemeral in their popularity, that imitations are as risky to produce as are original efforts. The "Sheik" was exceptionally popular, and within 2 months was followed by a dozen other cinemas, featuring Egyptians, odalisks, and deserts. Most of these films, however, were 2 months too late. Public

taste changes even more quickly in the "movies" than it does in clothing, or in literature.

Another tendency studied statistically, in preparation for a more intensive examination of rental forecasts, was the attendance at picture houses. These studies corroborated the evidence indicative of popular fickleness. It was discovered, however, that the habits of audiences were more or less fixed; also, that picture-goers were divisible into distinct groups.

A study of these groups and of their habits led to the study of the manner in which they received various films. This part of the research followed the regulation procedure of making market surveys. With these investigations as a preliminary, steps were taken to prognosticate actual sales, week by week. Attempts were made to do this even prior to the date of film release; but there was nothing tangible to use as a framework for statistics, and no expedient was discovered superior to the judgment of the producer himself. Even this, however, is often faulty. Many pictures which are expected to bring in fortunes fail miserably, while sometimes a film like "Humoresque," produced in the regular routine, and without expectation of unusual popularity, will meet with spectacular success.

From the statistical standpoint, therefore, it was found necessary to introduce the motto "Predict on Performance." In other words, it was found possible to forecast bookings only after it was found what reception the films enjoyed after release, and after examination of sales statistics resulting from its initial popularity. By plotting the curve of the

rentals of the first few weeks, however, the earnings of the film for the remainder of its life could be estimated with a gratifying degree of accuracy.

Studies showed that approximately 15 weeks after release the average film had brought in half its income (see Fig. 42). The profile of the curve was drawn by determining such significant points as these.

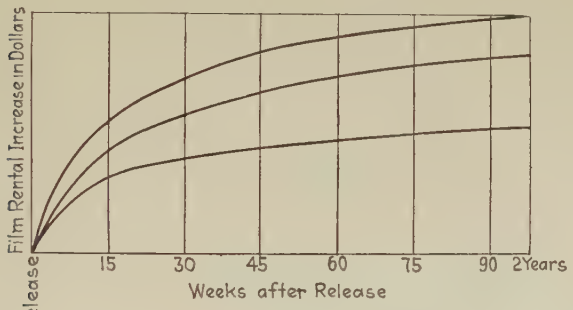


Fig. 42.—Statistical studies of film rentals have shown that the average age film brings in 5 per cent of its revenue by about the fifteenth week, and that by 2 years after release its earnings have ceased. By means of graphical and statistical analyses, extremely accurate forecasts have been made as to the sales of films.

Thus, a standard, or normal, graph was established. Variations from the norm must, of course, be provided against, where special conditions enter. Such factors as an unusual advertising expenditure, or unusual business conditions, or an event of national significance, may make it necessary to modify the forecasting formula. No formula, of course, will be proof against such happenings as the Arbuckle incident. This, being unpredictable, resulted in a

large loss, and left one company with thousands of feet of film which have never been exhibited.

Against the income curve must be drawn the cost curve. Large sums are, of course, required to finance pictures during the production period. This expense must be met before any earnings accrue. But this is not the only burden. Costs of selling, advertising, and distribution continue throughout the life of the film, and at last reduce the profit to the vanishing point.

The value of such predictions as these is obvious. To know, from a study of the sales of only a few weeks, what a film's entire sales performance will amount to means opportunities for economy and for profit in the entire marketing process. But even more important than the forecast of the rentals of a single film is the forecast of the company's gross earning over a considerable period in the future. The film-producing company has heavy charges to meet as the result of making pictures. Large loans are contracted, and these must eventually be met out of the company's sales. Consequently, it is of vital importance to the company's treasurer to know what funds will be available at any given future date.

Although this may, at first, appear a more difficult problem than the forecasting of the rental income from a single film, it is, in effect, an easier one. The larger the number of items of a given class in a statistical computation, the less likelihood there is for any single abnormal item to throw the aggregate out of line. Thus, it is far safer to predict sales volumes accruing from fifty films than that from one film.

A graph showing the company's gross earnings is similar in profile to that of a single film. It is, of course, merely a composite of the sales of all the company's films. In making up this composite picture of the company's gross receipts for a year or more in the future, the statistician of the film company accomplished the objective at which he had been aiming—the development of a guide to the future which should be positive, comprehensive, and accurate. So completely was this purpose attained that the error in forecasting did not exceed 1.5 per cent, for a period of 8 weeks in advance. This is a surprisingly small error, and speaks well for the wider application of statistical procedure to sales forecasting.

CHAPTER XVII

MANAGEMENT

Management is impossible without forecasting. In fact, the management function is fully one-half a planning function. Every plan is necessarily founded on an expectation of what the future will bring. If there were only one place in business where prediction could be practiced, it would be vested in the management, because the major plan or management plan embraces every single plan, no matter how small a place it may occupy in the organization.

The primary function of management is to harmonize and coordinate affairs within the company with those which surround it. The manager is like the captain of a vessel. He not only has the crew and the ship to look after, but he also has the surrounding sea with which to contend with all its perils and dangers.

The small company has a definite advantage over the large company because all its plans are made and coordinated by one brain. But from every other point of view, the one-man company has become out of date. The problem, therefore, is to find better methods of correlating and coordinating the plans of a group of executives. The trouble with companies which fail is nearly always at the top. Mismanagement is often due to unsound predicting, or the failure to forge sound predictions into efficient plans, or the failure to coordinate these plans in practice.

Management Policies.—The great executives have been those who were in possession of the greatest amount of information, and who, by virtue of that information, were able to foresee events to come. These men were not willing to let other people share their advance information, but kept it strictly to themselves for their own selfish reasons, and on it laid the foundation of their success. But their power lay not only in having the facts in advance, but also in their being able to control the course of events on account of their great holdings.

The trend of modern business is away from secrecy. There is a constant growth in the application of cooperative methods. There is an almost uniform belief that all the members of the executive staff of a given company should be thoroughly acquainted with the company plans and policies, if the course of this company's affairs is to be well unified and coordinated. The bigger the organization is the more necessary this coordination becomes. In fact, one of the greatest sources of confusion in a big company often arises from the failure of minor executives to understand the company's aims.

The Major Plan.—The principal function of management is the development of the major plan, and the secondary function, the assignment of minor plans to the various departments. The major plan consists of the company's general policy and its aims. This necessarily presupposes a number of minor plans, all of which are subservient to the major plan, and which dovetail in with each other.

The major plan corresponds to what is known in the army as general orders. It is a sort of proclamation of what the company is going to do and instruction to everybody to carry the scheme out to the best advantage by the most direct methods.

The major plan in a small company, and, after all, in most companies, is usually very simple and can be set forth in two or three sentences. It is ordinarily built around the determination to sell a given quantity of a given product at a given price and within a given time.

This plan is invariably elaborated, becoming of great complexity in a company of large size. But the difference between big and small companies is that the major plan in the small company is very sharply defined in the mind of a single individual who absolutely controls the situation, who can support that major plan by secondary plans delegated to his various department heads, and who is in a position immediately to observe whether this purpose is being carried out. In a big company, it is necessary to replace one man by a group of men and one mind by several minds. This immediately introduces the danger that those minds will not work together with the same unity observed in the single mind of the small company executive.

Conferences.—It is in order to overcome the lack of centralized planning that modern companies have adopted the conference idea. Practically all conferences are planning conferences. They are held usually among the heads of the various departments, or other executives. The difficulty, however, with many

conferences is that these department heads are so obsessed with their own problems that they are not well qualified to contribute impersonally to the construction of the company's major policy. It is best, therefore, to have the best-balanced mind in control of the conference, regardless of how brilliant his associates may be.

Since conferences are usually composed of department heads, the members are practically all executives. They are well qualified to obtain results from other men, that is, to put into effect the instructions which they themselves receive. But executive ability is not necessarily accompanied by good judgment, and by the foresight which is becoming more and more essential to the conduct of every business. In addition to having conferences made up of department heads, it is desirable to introduce staff men, that is, men not of executive rank but men who act as advisers and consultants. Among such staff men, there is room in every sizable organization for a man specializing in making forecasts and plans.

The highly specialized point to which executive functions have been subdivided, making one man responsible only for a very narrow section of the work, often fails to develop those faculties necessary for the construction of well-balanced major plans. The ordinary executive is judged by the efficiency of his particular department, and it is hence natural that he should be willing to sacrifice the broader aspects of the company's problems because his own loom up so large. A staff man, therefore, who is unaffiliated with any particular department, who has a broad perspec-

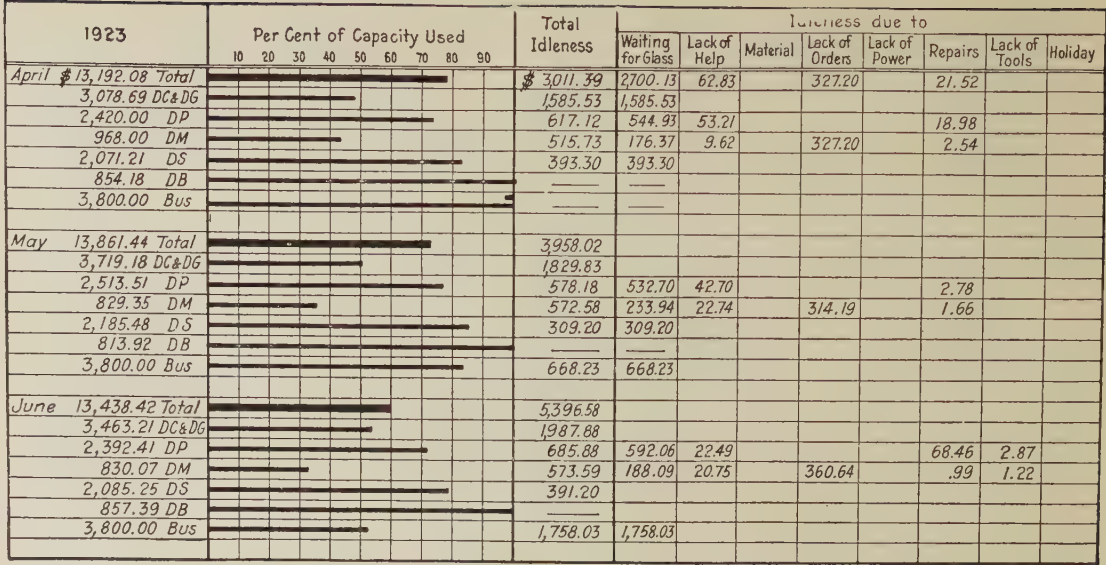
tive, and who is without bias, is a valuable part of the company organization.

Management Data.—Before the management can make plans, it is necessary to have the requisite data, first, concerning outside conditions, and, second, concerning the internal operations of the plant. For companies that have no planning departments, the heads of the individual departments will prepare statements at periodic intervals and submit them to the general manager, president, superintendent or other executive in charge of coordinating operations.

The following summary of tables and graphs illustrates what can be done by a planning department taking statistics from monthly cost sheets (Geoffrey C. Brown, Chief Engineer, Jacques Kahn, Inc., *Management and Administration*, November, 1923). See Fig. 43.

1. A comparative table of the month's predetermined and actual erhead expense.
2. A table of part shipment values and work in progress values.
3. A monthly statement of profit and loss.
4. A density chart showing graphically a cost analysis of the month's orders.
5. A Gantt idleness chart (see Fig. 1) showing by departments the monthly expense incurred through idle equipment.
6. Four simple cross-sectional charts which visualize monthly variations in:
   - *a*. Value of raw material in stockroom.
   - *b*. Work in progress inventory values.
   - *c*. Volume of output and unit costs.
   - *d*. Total cost and sales.

The amount of data required by the management will differ considerably according to the type of the



1923	Per Cent of Capacity Used (10 20 30 40 50 60 70 80 90)	Total Idleness	Idleness due to							
			Waiting for Glass	Lack of Help	Material	Lack of Orders	Lack of Power	Repairs	Lack of Tools	Holiday
April $13,192.08 Total		$ 3,011.39	2700.13	62.83		327.20		21.52		
3,078.69 DC&DG		1,585.53	1,585.53							
2,420.00 DP		617.12	544.93	53.21				18.98		
968.00 DM		515.73	176.37	9.62		327.20		2.54		
2,071.21 DS		393.30	393.30							
854.18 DB		—	—							
3,800.00 Bus		—	—							
May 13,861.44 Total		3,958.02								
3,719.18 DC&DG		1,829.83								
2,513.51 DP		578.18	532.70	42.70				2.78		
829.35 DM		572.58	233.94	22.74		314.19		1.66		
2,185.48 DS		309.20	309.20							
813.92 DB		—	—							
3,800.00 Bus		668.23	668.23							
June 13,438.42 Total		5,396.58								
3,463.21 DC&DG		1,987.88								
2,392.41 DP		685.88	592.06	22.49				68.46	2.87	
830.07 DM		573.59	188.09	20.75		360.64		.99	1.22	
2,085.25 DS		391.20								
857.39 DB		—								
3,800.00 Bus		1,758.03	1,758.03							

FIG. 43.—Gnatt idleness chart. (*Management and Administration.*)

business. In some businesses, for example, the purchases may require close supervision. The statistical department of the Eastman Kodak Company prepares a series of charts which allows the executive to see at a glance exactly what the situation at the moment is. There are three major series of charts:

1. A series of price-trend charts for each important raw material.

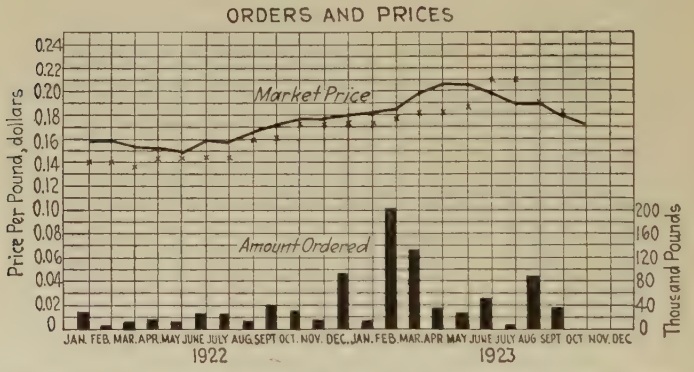


FIG. 44.—Chart used by Eastman Kodak Co. (*Harvard Business Review.*)

2. A chart for each important raw material showing size of orders placed by means of bars, prices paid by means of crosses, and a curve of the market price (see Fig. 44).

3. A chart showing a curve of the quantity inventory at the first of the month, a bar showing the receipts during the month, and a curve of the consumption during the month (see Fig. 45).

The second chart shows the management whether the purchasing department is functioning efficiently, and whether it is placing orders at the right time.

The chart shows that the price paid by the purchasing department was almost always under that of the current market price.

The third chart shows the condition of inventories by comparing the inventory line with the line of consumption.

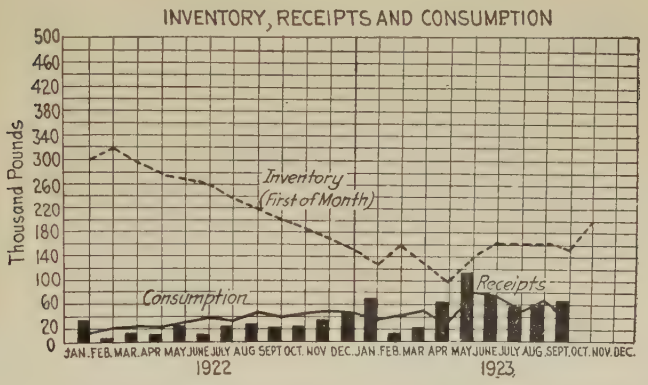


FIG. 45.—Chart used by Eastman Kodak Co. (*Harvard Business Review.*)

The data furnished by the production department to the management will ordinarily include the following:

1. Output, both total and itemized according to classes.
2. Costs of manufacture.
3. Wages.
4. Efficiency of men and machines.
5. Schedules and progress made.
6. Miscellaneous data varying with type of concern.

The sales department will naturally furnish the management with complete reports of sales, preferably by classes of products, by geographical divisions, or

by other classification peculiar to the industry or business.

Data will also be required from the advertising department. If a budget system is used, it will be found much easier to keep track of all such activities since the monthly report will merely show how the major plan is being carried out.

Coordination of Activities.—The activities of any given company are coordinated in two ways: In the

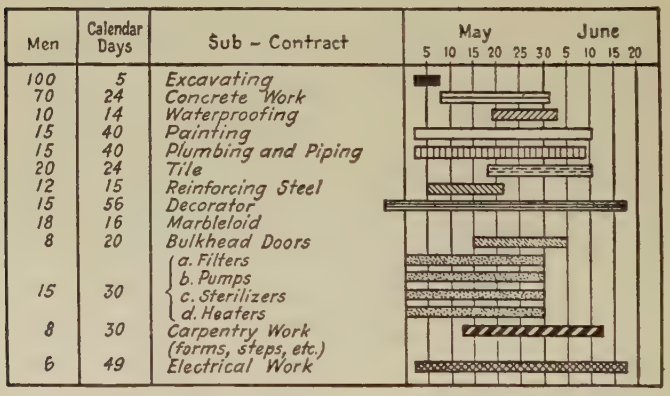


FIG. 46.—Progress chart showing a minimum of delay or interference between the various types of work. (*Management and Administration.*)

first place, it is possible and advisable in almost every case to plan ahead carefully so that all activities will work in harmony with each other. This calls for a progress chart of some kind which will show how many sales must be made to make a certain profit, how many products must be made and of what kind, how much material must be bought for production requirements, etc. The second type of coordination is founded on

the statistical tabulation of facts, according to which the activities of the company are adjusted periodically.

Figure 46 illustrates a progress chart used in erecting a large swimming pool. With a given length of time in which to complete the operation, each particular activity was scheduled for a certain time so that there would be a minimum of delay and interference. This is an example of advance coordination where the factors in the equation are practically all known. In the ordinary case, however, the factor of demand is constantly changing, and this requires the compilation of statistics on which coordination may be based.

Figure 47 illustrates excellently the use of statistics as the basis for planning. Here the hourly traffic in the business section of a city is charted, showing the number of operators required to handle the volume. There is a peak load between 9 and 10 a.m., followed by a sharp depression during the noon hour. There is a peak between 1 and 5 p.m., after which time business drops off steadily. In the residence sections, there is a high point around 9 a.m. when orders are being placed with retailers, and another around 7 p.m. when social engagements are being made. In the shopping districts, the greatest number of calls comes between 3 and 4 p.m.

Allowance, of course, must be made for out-of-the-ordinary occasions. For example, an accident, a fire, or other unusual occurrence will put on a bigger load. Similarly, traffic is heavier on a rainy day. The company, however, through its charts, collected and made up by local managers, can forecast with

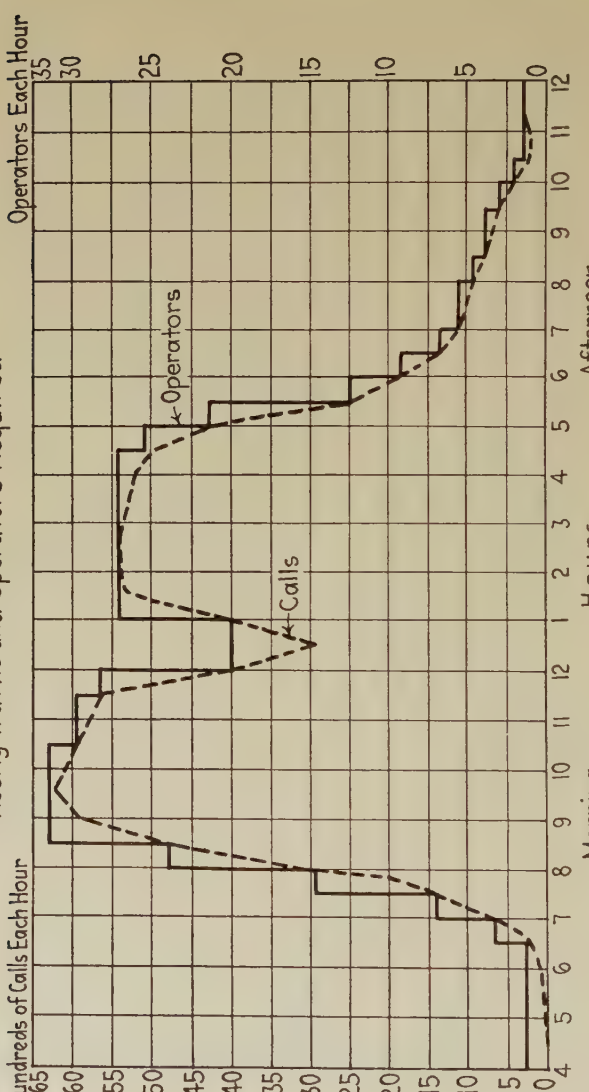


FIG. 47.—Looking ahead to meet the day's peak. The habit of looking ahead for an hour has value when business forecasting is locally applied. Each local manager collects records of performance under local conditions for local guidance. In this typical chart the number of workers is fitted to each hour's needs, with resulting economy in salaries, but without crippling service.

great accuracy the number of operators required at each hour of the day and during emergencies.

Another case where statistics can be used to coordinate activities is shown by a hotel. The Van Orman chain of three hotels in the Middle West has developed a system of coordinating purchases, prices, and expenditures in the kitchen and café. The food controller lists each item purchased according to the purpose for which it will be used. He then analyzes the sales checks carefully. He finds, for example, that for the *table-d'hôte* dinner, the distribution of each course is as follows:

Hors d'oeuvres	$ .10
Soup	.05
Fish	.20
Entree	.60
Potatoes	.05
Vegetables	.10
Salad	.10
Ice cream or pastry	.15
Tea, milk, or coffee	.10
Bread and butter	.05
Total	$1.50

Coordination of production and sales in the oil industry may be obtained, according to E. G. Reynolds, writing in *Management and Administration*, by:

1. Analysis of the size and character of the market.
2. Economic studies forecasting the trend of the potential market.

3. Predetermination of what the sales performance should be or establishment of quotas, based upon physical measurement of the market.

4. Setting a production schedule to conform with predetermined sales.

5. Basing purchase program of crude oil upon production schedule.

6. Developing a device for making monthly estimates of surplus production and the regulation of its disposal to fluctuations in prices.

7. Providing records which will reflect the progress of refinery operations and department sales.

8. Studying price relationships.

Almost every company can work out some such schedule of coordination to suit its own needs.

An Example of Coordination.—The following example illustrates how a system may be introduced into a business, whereby coordination is more or less automatically effected. Though in this instance control is vested in the sales department, this control is merely nominally so vested, for the coordination is actually between all operating departments.

The Phoenix Silk Mills, Inc., of New York City, have a difficult problem of material control, as every piece of goods handled must be kept strict account of. In case any defect develops, even after the goods are in actual use by the consumer, it must be possible to trace the defect to its source. This is a delicate problem, particularly since the silk has to travel through so many hands.

A card is made out for each individual piece of silk in the house. Each piece has its own number, and it is this feature which makes it possible to

trace goods long after they have been sold and made into garments.

The card gives a complete description of the piece, such as its serial number, style number, color, date received, number of yards, cost per yard, and cost of the whole piece. These cards, collectively, constitute a complete inventory of the merchandise on hand. In fact, an inventory is made up from these cards once every month, or as often as may be required. Actual physical inventory serves as a check on this, and has to be made only once or twice a year.

When any piece of silk is sold, further data are entered on the card, in spaces provided, such as the customer, his address (state and town), his classification (such as retailer or jobber), the salesman, and the price. The card, containing this complete description and sales history of the piece of silk, measures only about 3¼ by 7¼ inches.

But that is not all. Whereas most of the information is entered on the card in plain English, this same information is also recorded on the card by means of a punch. This punch perforates the card at certain points, with a plain round hole. Thus, the whole story is recorded by varying the positions of the holes. A hole at one point in the card, for instance, will mean that Charles Douglas made the sale, while at another point will mean that Arthur Doe made it, and so on.

It may now be assumed that all the cards representing sales of pieces for the previous month are ready for analysis. There are any number of ways in which this analysis may be made. For example, the cards may be sorted by salesmen, with a view to learning how

much each man's sales amounted to; or, the sales may be divided according to towns and cities, or by classes of trade, or by lines of merchandise, or by customers. More complicated classifications are possible, such as sales per customer per unit of time; that is, two or more factors may be introduced.

The analysis of sales is effected by sorting the cards into piles, or groups. All the cards representing sales made by one salesman might, for instance, be put into one pile, and so on. This is all done automatically, by means of a sorting machine. A selector mechanism, using the punched holes as guides, groups all the cards of a given class together.

It is possible to classify cards into many subdivisions. If, for example, the number of sales per company for a given period is required, the cards are first sorted according to companies. When the selection has been completed, the cards are again run through the machine, and it now culls out the cards, ordering them according to date. Thus, an unlimited degree of differentiation is possible.

So far in the process, the cards have simply been sorted into groups. But they are still merely piles of cards, and not very intelligible. A tabulation must, therefore, be made. For this purpose a tabulating machine is provided, operated by the passage of the cards through its mechanism, the punched holes coming into register with certain pins which actuate levers, not unlike those found in a typewriter or adding machine. These print figures on a sheet of paper. As the cards pass through the tabulating machine, totals may be obtained, by an adding mechanism.

Tabulations may thus be made in many ways. A complete operating statement may be drawn up. A salesmen's commission summary may be compiled. A set of "history sheets" may be taken off, showing the movement of various grades of merchandise. (These three kinds of statements are periodically set up by the Phoenix Silk Company, Inc.)

These general methods of coordination may be applied to almost any business. The analysis, to be effective, must be made promptly, so that the executive can use the results as a basis for his plans.

Under the plan described, the manager can keep abreast of his work. He knows without question what lines are moving rapidly, what shortages threaten, what territories are producing their quotas, what customers are buying well, what salesmen are most productive, and where the profit is being made. With such facts at his finger tips, the planning of even the most extensive campaign becomes comparatively easy.

Management and Finance.—In most businesses, the chief executives are primarily concerned with matters of finance. Men who have received their training in the production or sales departments are often seen in the position of chief executive. The real control of the business, however, is inherently financial.

The management function is largely a financial one because conditions in the world at large are measured in monetary terms. Money is the least common multiple of all businesses. The financial man in the company is looked to by his associates for a knowledge

of fundamental conditions, and for a broad-gage understanding of the particular industry in question.

As described in a previous chapter, it is the function of the treasurer to control the working capital of the company by preparing in advance for contingencies. It is his further duty to outline the price policy. This does not necessarily mean the specific price, which may vary at frequent intervals, but the guiding principles which will determine the price policy as a whole. This will be a composite of trends in manufacturing and selling costs, inventory on hand, market demand, profits, competition, and perhaps still other factors. For example, the theory of pricing used by General Motors Corporation attempts to gain over a fairly lengthy period of time a margin of profit which represents the highest attainable return commensurate with capital turnover and wholesome expansion, with adequate regard to the economic consequences of fluctuating volume.

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